Padasalai's Telegram Groups!

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WAY TO SUCCESS

Leads to Success

10

SCIENCE

June Month Study material

- ★ **Physics (1 Unit)** – 1. Laws of Motion
- ★ **Chemistry (1 Unit)** – 7. Atoms and Molecules
- ★ **Biology (2 Units)** – 12. Plant Anatomy and Plant Physiology
  – 18. Heredity

Dear Teachers! & Students!

We publish this study material on the request of many teachers and students. This study material contains only Book back exercise questions for June month Units. Way to success – 10th Science guide will be published very shortly. Way to success is preparing 10th Science guide based on Govt.New Pattern with the help of expert cum experienced teachers to give an assurance for you to score high marks in your public examination.

Best Wishes to All.....

Way to Success team

UNIT - 1
LAWS OF MOTION

POINTS TO REMEMBER

Mechanics	A branch of physics that deals with the effect of force on bodies. ✓ **Statics:** The study of bodies, which are at rest under the action of forces. ✓ **Dynamics:** The study of moving bodies under the action of forces. ❖ **Kinematics**: Dynamics that do not consider the cause of motion. ❖ **Kinetics:** Dynamics that consider the cause of motion.
Natural motion (Force independent)	If a moving body naturally comes to rest without any external influence of the force, such motions are termed as natural motion.
Violent motion (Force dependent)	If a force is required to make bodies to move from their natural state (rest) and behave contrary to their natural state, such motions are called as violent motion.
Inertia	It is the inherent property of a body to resist any change in its state (rest or motion), unless it is influenced by an external unbalanced force. ✓ **Inertia of rest:** The resistance of a body to change its state of rest ✓ **Inertia of motion**: The resistance of a body to change its state of motion. ✓ **Inertia of direction:** The resistance of a body to change its direction of motion.
Linear Momentum	It is the product of mass and velocity of a moving body that acts in the direction of the velocity of the object. It is a vector quantity.
Force	An external effort in the form of push or pull. It is a vector quantity. Types: Like parallel forces, Unlike parallel forces
Torque	The rotating or turning effect of a force about a fixed point or axis is called torque (τ). It is a vector quantity. Its SI unit is N m. **Application:** Gear, Seasaw, Steering Wheel
Couple	Two equal and unlike parallel forces applied simultaneously at two distinct points constitute a couple.
Impulse	A large force acting for a very short interval of time is called as '**Impulsive force'**.
Mass	It is defined as the quantity of matter contained in a body. Its SI unit is kilogram (kg).
Weight	It is defined as the gravitational force exerted on a body due to the Earth's gravity alone. Its SI unit is Newton(N).
Newton's 1st Law (or) Law of Inertia	The law states that everybody continues to be in its state of rest or the state of uniform motion along a straight line unless it is acted upon by some external force.
Newton's 2nd Law (or) Law of Force	Force acting on a body is directly proportional to the rate of change of linear momentum of the body. The change in momentum takes place in the direction of the force.

Newton's 3rd Law (or) Conservation of momentum	For every action, there is an equal and opposite reaction. They always act on two different bodies. **Application:** Propulsion of rocket.
Newton's Law of gravitation	The law states that gravitational force between two bodies is directly proportional to the product of their masses and inversely proportional to the square of the distance between the centers of these masses. The direction of the force acts along the line joining the masses. F = $\frac{Gm_1m_2}{r^2}$

FORMULAE

Important Formulae

- ★ Linear Momentum : p =m × v
- ★ Torque : τ = F × d
- ★ Momentum of a couple : M = F × S
- ★ Force : F = m × a
- ★ Impulse : J = F × t = Δp
- ★ Gravitational Force : F = $\frac{Gm_1m_2}{r^2}$
- ★ Acceleration due to gravity : g = $\frac{GM}{R^2}$
- ★ Weight : W = m × g
- ★ Change in momentum : $\Delta p = P_f - P_i$
- ★ Kinetic Energy : $E_k = \frac{1}{2}mv^2 = \frac{p^2}{2m}$

Important Values to remember

- ★ Acceleration due to gravity(g) = 9.8 m s^{-1}
- ★ Radius of Earth (R) ≅ 6378km
- ★ Mass of Earth (M) = 5.972 × 10^{24}kg
- ★ 1N = 1 kg m s^{-1} = 10^5 dyne
- ★ 1 kg f = 9.8 N = 98 × 10^4 dyne
- ★ 1 g f = 9.8 × 10^{-3}N= 980 dyne

Important Principles

- ★ At equilibrium, the algebraic sum of the moments of all the individual forces about any point is equal to zero.
- ★ ***Conservation of Linear Momentum:*** In the absence of an external force, the algebraic sum of the momentum after collision is numerically equal to the algebraic sum of the momentum before collision.

TEXTBOOK QUESTIONS

I. Choose the correct answer

1. Inertia of a body depends on
   a) weight of the object
   c) mass of the object
   b) acceleration due to gravity of the planet
   d) Both a & b
2. Impulse is equals to
   a) rate of change of momentum
   c) change of momentum
   b) rate of force and time
   d) rate of change of mass
3. Newton's III law is applicable
   a) for a body is at rest
   c) both a & b
   b) for a body in motion
   d) only for bodies with equal masses

4. Plotting a graph for momentum on the X-axis and time on Y-axis. Slope of momentum-time graph gives
   a) Impulsive force b) Acceleration
   c) Force d) Rate of force
5. In which of the following sport the turning of effect of force used
   a) swimming b) tennis ***c) cycling*** d) hockey
6. The unit of 'g' is m s^{-2}. It can be also expressed as
   a) cm s^{-1} ***b) N kg^{-1}*** c) N m^2 kg^{-1} d) cm^2 s^{-2}
7. One kilogram force equals to
   a) 9.8 dyne b) 9.8×10^4 N ***c) 98×10^4 dyne*** d) 980 dyne
8. The mass of a body is measured on planet Earth as M kg. When it is taken to a planet of radius half that of the Earth then its value will be ____ kg
   a) 4 M b) 2M c) M/4 **d) M**

   [Hints: Mass of a body remains same]
9. If the Earth shrinks to 50% of its real radius its mass remaining the same, the weight of a body on the Earth will
   a) decrease by 50% b) increase by 50%
   c) decrease by 25% **d) increase by 300%**

   [Hints: $R' = \frac{50}{100} R = 0.5R$; $g = \frac{GM}{R^2} \Rightarrow g' = \frac{GM}{(0.5R)^2} = \frac{g}{0.5^2} = 4g$

   $W' = m \times g' = m \times 4g = 4W = W + 3W$

   This can be said as weight increases by 3times (or) 300%]
10. To project the rockets which of the following principle(s) is /(are) required?
    a) Newton's third law of motion
    b) Newton's law of gravitation
    c) law of conservation of linear momentum
    d) both a and c

II. Fill in the blanks

1. To produce a displacement ***unbalanced force*** is required.
2. Passengers lean forward when sudden brake is applied in a moving vehicle. This can be explained by ***inertia / Newton's first law.***
3. By convention, the clockwise moments are taken as ***negative*** and the anticlockwise moments are taken as ***positive.***
4. ***Gears*** is used to change the speed of car.
5. A man of mass 100 kg has a weight of ***980 N*** at the surface of the Earth

III. State whether the following statements are true or false. Correct the statement if it is false

1.	The linear momentum of a system of particles is always conserved ***(Corrected statement:*** The linear momentum of a system of particles is conserved when no external force is applied*)*	**False**

2.	Apparent weight of a person is always equal to his actual weight ***(Corrected statement:** Apparent weight of a person is **equal** to his actual weight when he/lift is at **rest**)*	**False**
3.	Weight of a body is greater at the equator and less at the polar region ***(Corrected statement:** Weight of a body is **less** at the equator and **greater** at the polar region)*	**False**
4.	Turning a nut with a spanner having a short handle is so easy than one with a long handle. ***(Corrected Statement:** Turning a nut with a spanner having a **long** handle is so **easy** than one with a short handle).*	**False**
5.	There is no gravity in the orbiting space station around the Earth. So the astronauts feel weightlessness. ***(Corrected Statement:** Astronauts and orbiting space station are under free fall with same acceleration, so the astronauts feel weightlessness).*	**False**

IV. Match the following

Column I	Column II
a) Newton's I law	propulsion of a rocket
b) Newton's II law	Stable equilibrium of a body
c) Newton's III law	Law of force
d) Law of conservation of Linear momentum	Flying nature of bird

Answer
a) Stable equilibrium of a body
b) Law of force
c) Flying nature of bird
d) propulsion of a rocket

V. Assertion & Reasoning

Mark the correct choice as

(a) If both the assertion and the reason are true and the reason is the correct explanation of assertion.
(b) If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
(c) Assertion is true, but the reason is false.
(d) Assertion is false, but the reason is true.

1. Assertion: The sum of the clockwise moments is equal to the sum of the anticlockwise moments.
Reason : The principle of conservation of momentum is valid if the external force on the system is zero.

Ans. (b) ***Both the assertion and the reason are true, but the reason is not the correct Explanation of the assertion.***

2. Assertion: The value of 'g' decreases as height and depth increases from the surface of the Earth.
Reason : 'g' depends on the mass of the object and the Earth.

Ans. (c) ***Assertion is true, but the reason is false.***

VI. Answer briefly

1. Define inertia. Give its classification.

The inherent property of a body to resist any change in its state (rest or motion), unless it is influenced by an external unbalanced force.

Classification of Inertia

- ❖ Inertia of rest
- ❖ Inertia of motion
- ❖ Inertia of direction

2. Classify the types of force based on their application.

Types of Forces:

(i) Like parallel force

(ii) Unlike parallel force

3. If a 5 N and a 15 N forces are acting opposite to one another. Find the resultant force and the direction of action of the resultant force

Given , $F_1 = 5N$ $F_2 = 15\ N$

Two forces acting opposite to one another. Therefore, Resultant force is,

$F_{net} = F_2 - F_1$

$F_{net} = 15 - 5 = 10\ N$. The direction of F_{net} *is* F_2.

4. Differentiate mass and weight.

Mass	Weight
1. Fundamental quantity	1. Derived quantity
2. Quantity of matter contained in the body	2. Gravitational force exerted on it due to the Earth's gravity
3. Its unit Kg	3. Its unit Newton
4. It is a scalar quantity	4. It is a vector quantity

5. Define moment of a couple.

The line of action of two forces in a couple does not coincide. It does not produce any translatory motion since the resultant is zero. But it causes the rotation of the body. Rotating effect of a couple is known as moment of a couple.

6. State the principle of moments.

When a number of like or unlike parallel force act on a rigid body and the body is in equilibrium, then the algebraic sum of the moments in the clockwise direction is equal to the algebraic sum of the moments in the anticlockwise direction.

(or)

At equilibrium, the algebraic sum of the moments of all the individual forces about any point is equal to zero.

7. State Newton's second law.

The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force.

$$\mathbf{F \propto \frac{mv - mu}{t}}$$

8. Why a spanner with a long handle is preferred to tighten screws in heavy vehicles?

- When the handle of the spanner is long, the force required to turn the body is less.
- The turning effect of a body depends upon the perpendicular distance of the line of action of the applied force from the axis of rotation.

Moment of force = F× d

- Hence, the spanner has a long handle is preferred to tighten screws in heavy vehicles.

9. While catching a cricket ball the fielder lowers his hands backwards. Why?

- A fielder experiences a smaller force for a longer interval of time to catch the ball, resulting in a lesser impulse on his hands.
- Thus he pulls back his hand while catching the ball.

10. How does an astronaut float in a space shuttle?

- Astronauts are not floating but falling freely around the Earth due to their huge orbital velocity.
- Since space station and astronauts have equal acceleration, they are under free fall condition. Hence, both the astronauts and the space station are in the state of weightlessness.

VII. Solve the given problems :

1. Two bodies have a mass ratio of 3:4. The force applied on the bigger mass produces an acceleration of 12 ms^{-2}.What could be the acceleration of the other body, if the same force acts on it.

Given data

$m_1 : m_2 = 3:4$ $\qquad F_1 = F_2$

Let bigger mass be m_2, then a_2 = 12 ms^{-2}

Solution

We know F = ma

$$\frac{F_1}{F_2} = \frac{m_1}{m_2} \times \frac{a_1}{a_2} \quad \Rightarrow \quad 1 = \frac{3}{4} \times \frac{a_1}{12} \quad \Rightarrow \quad a_1 = 16\, ms^{-1}$$

∴ Acceleration of the other body is 16 ms^{-1}

2. A ball of mass 1 kg moving with a speed of 10 ms^{-1} rebounds after a perfect elastic collision with the floor. Calculate the change in linear momentum of the ball.

Given data

Mass of ball (m) = 1kg

Initial velocity (v_i) = 10 ms^{-1}

Initial velocity (v_f) = -10 ms^{-1}

(since it is perfect elastic collision, ball rebound with the same speed but in opposite direction)

Solution

$$\Delta p = mv_f - mv_i = m(v_f - v_i)$$

= 1 × (-10-10) = -20 *kgms^{-1}* *(Negative sign just indicates the direction of momentum)*

∴ Change in linear momentum of the ball is 20 $kgms^{-1}$

3. A mechanic unscrew a nut by applying a force of 140 N with a spanner of length 40 cm. What should be the length of the spanner if a force of 40 N is applied to unscrew the same nut?

Force $F_1 = 140\ N$, Length $L_1 = 40\ cm$

Force $F_2 = 40\ N$, Length $L_2 = ?$

Moment of couple is same for both the spanner, and so

$$F_1 L_1 = F_2 L_2$$

$$L_2 = \frac{F_1 L_1}{F_2} = \frac{40 \times 140}{40} = 140\ cm$$

∴ If a force 40 N is applied, the length of the spanner should be 140 cm

4. The ratio of masses of two planets is 2:3 and the ratio of their radii is 4:7. Find the ratio of their accelerations due to gravity.

Given data

Ratio of mass $m_1 : m_2 = 2:3$

Ratio of radius $R_1 : R_2 = 4:7$

Ratio of acceleration due to the gravity = $g_1 : g_2$ = ?

Solution

$$g_1 = \frac{GM_1}{R_1^2} \text{ ---- (1)} \qquad g_2 = \frac{GM_2}{R_2^2} \text{ ------ (2)}$$

(1) / (2). $\frac{g_1}{g_2} = \frac{\frac{GM_1}{R_1^2}}{\frac{GM_2}{R_2^2}}$

$$\frac{g_1}{g_2} = \frac{GM_1}{R_1^2} \times \frac{R_2^2}{GM_2}$$

$$\frac{g_1}{g_2} = \frac{M_1}{M_2} \times \frac{R_2^2}{R_1^2}$$

$$\frac{g_1}{g_2} = \frac{2}{3} \times \frac{7^2}{4^2} = \frac{2}{3} \times \frac{49}{16_8} = \frac{49}{24}$$

∴ The ratio of acceleration due to gravity $g_1 : g_2$ = 49 : 24

VIII. Answer in detail :

1. What are the types of inertia? Give an example for each type.

Types and Explanation	Example
a) Inertia of rest: The resistance of a body to change its state of rest is called Inertia of rest.	When you vigorously shake the branches of a tree, some of the leaves and fruits are detached and they fall down.
b) Inertia of motion The resistance of a body to change its state of motion is called inertia of motion.	An athlete runs some distance before jumping. Because, this will help him jump longer and higher.
c) Inertia of direction The resistance of a body to change its direction of motion is called Inertia of direction.	When you make a sharp turn while driving a car, you tend to lean side ways.

2. State Newton's laws of motion?

a) Newton's First law

Everybody continues to be in its state of rest or the state of uniform motion along a straight line unless it is acted upon by some external force.

b) Newton's second law

The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force.

$$\mathbf{F \propto \frac{mv - mu}{t}}$$

c) Newton's third law

For every action, there is an equal and opposite reaction. They always act on two different bodies.

3. Deduce the equation of a force using Newton's second law of motion.

Newton's second law of motion

- The force acting on a body is directly proportional to the rate of change of linear momentum of the body and the change in momentum takes place in the direction of the force.

Derivation for the equation of force:

- Let 'm' be the mass of a moving body, moving along a straight line with an initial speed 'u'.
- After a time interval of 't' , velocity of the body changes to 'v' due to the impact of an unbalanced external force 'F'

Initial momentum of the body $P_i = mu$,

Final momentum of the body $P_f = mv$

Change in momentum $\Delta P = P_f - P_i$

$$\Delta P = mv - mu$$

$$F \propto \frac{Change\ in\ momentum}{time}$$

$$F \propto \frac{mv-mu}{t} \ , F = k\ \frac{mv-mu}{t}$$

K is proportionality constant , k = 1 in all systems of units.

$$F = \frac{mv-mu}{t} = m\left[\frac{v-u}{t}\right];$$

We know that, Acceleration a = $\frac{v-u}{t}$

$\therefore$ F = ma

Force = mass × acceleration SI unit of force is Newton.

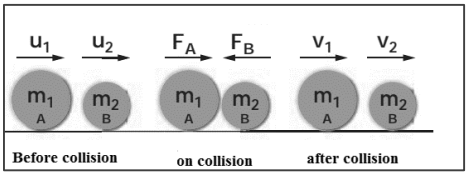
4. State and prove the law of conservation of linear momentum.

Law of Conservation of momentum:

Statement:

There is no change in the linear momentum of a system of bodies as long as no net external force acts on them.

Proof:



- Let two bodies A and B having masses m_1 and m_2 move in a straight line.
- Let initial velocities of A and B be u_1 and u_2 respectively such that $u_1 > u_2$.
- During an interval of time 't second', they tend to have a collision.
- After the impact, both of them move along the same straight line with a velocity v_1 and v_2 respectively.

Force on body B due to A,

$$F_B = \frac{m_2(v_2 - u_2)}{t} \text{ -------- (1)}$$

Force on body A due to B

$$F_A = \frac{m_1(v_1 - u_1)}{t} \text{ -------- (2)}$$

By Newton's third law, Action Force = Reaction force :

$$F_A = -F_B$$

$$\frac{m_1(v_1 - u_1)}{t} = -\frac{m_2(v_2 - u_2)}{t}$$

$$m_1(v_1 - u_1) = -m_2(v_2 - u_2)$$

$$m_1v_1 - m_1u_1 = -m_2v_2 + m_2u_2$$

$$\boxed{m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2}$$

In the absence of an external force, the algebraic sum of the momentum after collision is numerically equal to the algebraic sum of the momentum before collision.

5. Describe rocket propulsion.

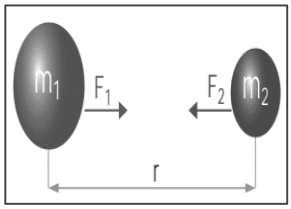
- ***Principle:*** Law of conservation of linear momentum and Newton's III law of motion.
- Rockets are filled with a fuel (either liquid or solid) in the propellant tank.
- When the rocket is fired, this fuel is burnt and a hot gas is ejected with a high speed from the nozzle of the rocket, producing a huge momentum.
- To balance this momentum, an equal and opposite reaction force is produced in the combustion chamber, which makes the rocket project forward.
- In motion, the mass of the rocket gradually decreases, until the fuel is completely burnt out.
- There is no net external force acting on it, and so the linear momentum of the system is conserved. The mass of the rocket decreases with altitude, which results in gradual increase in velocity of the rocket.
- At one stage, it reaches escape velocity, which is sufficient to just escape from the gravitational pull of the Earth.

6. State the universal law of gravitation and derive its mathematical expression.

Newton's Universal gravitational law

- Every particle of matter in this universe attracts every other particle with a force. This force is directly proportional to the product of their masses and inversely proportional to the square of the distance between the centers of these masses.
- The direction of the force acts along the line joining the masses.

Mathematical Expression of Universal gravitational law:



Let, m_1 and m_2 be the masses of two bodies A and B placed 'r' meter apart in space.

$F \propto m_1 m_2$ --------- (1) $\quad F \propto \frac{1}{r^2}$ --------- (2)

On combining (1) and (2), $F \propto \frac{m_1 m_2}{r^2} \Rightarrow F = G\frac{m_1 m_2}{r^2}$

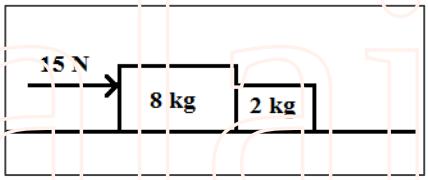
Where G - Universal gravitational constant $\quad G = 6.674 \times 10^{-11} Nm^2 kg^{-2}$

7. Give the applications of universal law of gravitation.

1) Heavenly bodies like stars and planets can be discovered and their dimensions and path can also be measured using the gravitation law.
2) Mass of the Earth, radius of the Earth, acceleration due to gravity, etc. can be calculated with a higher accuracy.
3) It maintains the motion of all the planets around the sun and moon around the earth.
4) It pulls all the object towards the earth so that we are not flying in atmosphere or space.
5) It helps to maintain the water flow in the rivers and seas.

IX. HOT Questions :

1. Two blocks of masses 8 kg and 2 kg respectively lie on a smooth horizontal surface in contact with one other. They are pushed by a horizontally applied force of 15 N. Calculate the force exerted on the 2 kg mass.



Given Data:

$m_1 = 8\ kg\ ,\ m_2 = 2\ kg$

Horizontal applied force F = 15 N

According to Newton's Second law, F = ma

$F = (m_1 + m_2)\ a$

$a = \frac{F}{m_1+m_2} = \frac{15}{8+2} = \frac{15}{10} = 1.5\ ms^{-2}$

Force exerted on the 2kg mass, $m = 2\ kg \quad a = 1.5\ ms^{-2}$

F = ma = 2× 1.5 = 3N

The force exerted on the 2kg mass is F = 3N.

2. A heavy truck and bike are moving with the same kinetic energy. If the mass of the truck is four times that of the bike, then calculate the ratio of their momenta.

Mass of the bike = m_1

Mass of the truck = $m_2 = 4m_1$

Kinetic energy = $\frac{1}{2}mv^2 = \frac{p^2}{2m}$

Truck and bike have same kinetic energy, $K_1 = K_2$

$$\frac{p_1^2}{2m_1} = \frac{p_2^2}{2m_2}$$

$$\left[\frac{p_1}{p_2}\right]^2 = \left[\frac{2m_1}{2m_2}\right] = \frac{m_1}{4m_1} = \frac{1}{4}$$

$$\frac{p_1}{p_2} = \frac{1}{2}$$

∴ The ratio of momenta is **1 : 2**

3. "Wearing helmet and fastening the seat belt is highly recommended for safe journey" Justify your answer using Newton's laws of motion.

Wearing helmet is highly recommended for safe journey:

- ❖ When you fall from a bike on the ground, you will fall with a force equal to your mass and acceleration of the bike, based on Newton's second law.
- ❖ According to Newton's third law, an equal and opposite reacting force from the ground is exerted on you.
- ❖ When you do not wear helmet, this reacting force can cause fatal head injuries. So it is important to wear helmet for the safe journey.

Fastening the seat belt is highly recommended for safe journey:

- ❖ When our vehicle comes to a quick stop, by Newton's first law, we move forward and stay in motion until an unbalanced force acts upon us.
- ❖ If don't wear a seat belt, we would get hurt during this motion.
- ❖ If we wear a seat belt, the seat belt acts as an unbalanced force that would stop you from being in motion.

ADDITIONAL QUESTIONS

I. Choose the best answer:

1. The S.I. unit of force is
   a) Kgm/s b) Kgm/s^2 **c) Newton** d) Newton-meter
2. The rate of change of momentum of an object is proportional to
   a) Mass of the body b) Velocity of the body
   c) Net force applied on the body d) None of these
3. A fielder giving a swing while catching a ball is an example of
   a) Inertia b) Momentum
   c) Newton's II law of motion d) Newton's I law of motion
4. A system can be brought to equilibrium by applying a force which is
   a) equal in magnitude but opposite in direction as that of resultant force
   b) equal in magnitude and in same direction as that of resultant force
   c) greater than the magnitude of resultant force but in opposite direction
   d) greater than the magnitude of resultant force and in same direction
5. Change in momentum can be achieved by,
   a) a large force acting for a short period of time
   b) a large force acting for a longer period of time
   c) a short force acting for a longer period of time
   d) both a and c
6. Qualitative definition of force is given by
   a) Newton's first law of motion.
   b) Newton's second law of motion.
   c) Newton's third law of motion.
   d) Newton's law of gravitation.

7. A rider on a horseback falls back when horse starts running all of a sudden because
   a) Rider is taken back.
   b) Rider is suddenly afraid of falling.
   c) Inertia of rest keeps the upper part of body at rest whereas the lower part of the body moves forward with the horse.
   d) None of the above.
8. An athlete runs some distance before taking a long jump because
   a) He gains energy to take him through long distance.
   b) It helps him to apply large force.
   c) By running action and reaction forces increase.
   d) he gains inertia of motion during his run.
9. When a lift is moving upward, apparent weight is _____
   a) greater than actual weight b) lesser than actual weight
   c) same as actual weight d) Zero
10. Astronauts feel weightlessness in space because
    a) there is no gravitational force in space b) they are floating in space
    c) they are under free fall condition d) they wear a weightless coat
11. **Reason (R) :** Two equal and unlike parallel forces applied simultaneously at two distinct points constitute a couple.
    Assertion (A): The line of action of the two forces of a couple does not coincide.
    a) (R) True (A) True b) (R) True (A) False
    c) (R) False (A) True d) (R) False (A) False
12. **Reason (R) :** Couple does not produce any translatory motion.
    Assertion (A) : The resultant force of a couple is zero.
    a) (R) True (A) True, R Explain A b) (R) True (A) True R does no explain A
    c) (R) True (A) False d) (R) False (A) True

I. Fill in the blanks :

1. Unit of momentum in SI system ***Kgms^{-1}.***
2. A body will be in equilibrium, if the resultant force of all the forces acting on the body is equal to ***zero.***
3. A system which is in equilibrium is called as ***Equilibrant.***
4. Parallel forces F_1 , F_2 are acting in the same direction, then the resultant force is ***$F_1 + F_2$.***
5. Parallel equal forces are acting in opposite direct ions in the same line of action, then resultant force is ***zero***.
6. The ***linear momentum*** measures the impact of a force on a body.
7. 1 Newton = ***10^5 dyne.***
8. If lift is falling down freely, apparent weight is equal to ***zero.***
9. ***Impulsive force*** is a large force acting for a short period of time.
10. Newton' s second law of motion is also called ***law of force***.
11. Action of a lever is an example of ***Unbalanced Force.***
12. Impulse is also equal to the magnitude of ***change in momentum.***
13. The SI unit of impulse ***kgms^{-1} / Ns.***
14. The SI unit of gravitational unit of force is ***kgf.***

15. Value of Universal gravitational constant $\underline{\boldsymbol{6.674 \times 10^{-11} Nm^2 kg^{-2}}}$
16. Relation between g and G is $\underline{\mathbf{g = GM/R^2}}$
17. The value of g is ***zero*** at the center of the Earth.
18. The value of acceleration due to gravity on the surface of the moon is $\underline{\boldsymbol{1.625\ ms^{-2}.}}$
19. If a person whose mass is 60 kg stands on the surface of Earth, his weight would be 588 N, his weight in moon is ***97.5N.***
20. The acceleration due to gravity on the surface of the moon is about ***0.1654*** times the acceleration due to gravity of Earth.

II. Short answer questions :

1. When a carpet is beaten with a stick dust comes out of it. Explain.

When a carpet is beaten with a stick, dust comes out of it because carpet fibres vibrate in forward and backward direction as carpet is beaten but the loosely bound dust particles due to Inertia remain at rest and so they come out.

2. Define Linear momentum? Its unit?

The product of mass and velocity of a moving body gives the magnitude of linear momentum. It acts in the direction of the velocity of the object. Linear momentum is a vector quantity.

Linear momentum = mass × velocity

$$p = mv$$

- Unit of momentum in SI system $kgms^{-1}$.
- Unit of momentum in CGS system $gcms^{-1}$.

3. Distinguish between balanced force and unbalanced force?

Balanced force	Unbalanced force
1. The resultant forces is equal to zero	1. The resultant force is not equal to zero.
2. The body will be in equilibrium	2. It causes motion of the body

4. The door can be easily opened or closed when you apply the force at a point far away from the fixed edge. Explain.

The effect of the force you apply is to turn the door about the fixed edge. This turning effect of the applied force is more when the distance between the fixed edge and the point of application of force is more. So the door can easily be opened or closed when you apply the force at a point far away from the fixed edge.

5. Define torque?

- The rotating or turning effect of a force about a fixed point or fixed axis is called moment of the force about that point or torque (τ)
- It is measured as the product of the force (F) and the perpendicular distance (d) between the fixed point or the fixed axis and the line of action of the force $\tau = F \times d$
- The SI unit of moment of force N m.

6. Define Impulse?

- When a force F acts on a body for a short period of time t, then the product of force and time is known as Impulse. J = F × t
- Impulse is also known as magnitude of change of momentum J = Δ P
- SI unit of Impulse $kgms^{-1}$ (or) Nm

7. Which law is based on propulsion of rockets.

(i) Law of conservation of linear momentum

(ii) Newton's third law of motion

8. What is meant by apparent weight?

The weight that you feel to possess which is not the same as you weigh actually is called apparent weight.

9. Tabulate the apparent weight of a person in a moving lift

1. Lift is moving upward with an Acceleration 'a'	Apparent weight is greater than the actual weight (R>W)
2. Lift is moving downward with an acceleration 'a'	Apparent weight is lesser than the actual weight (R<W)
3. Lift is at rest	Apparent weight is equal to actual weight (R = W)
4. Lift is falling down freely.	Apparent weight is equal to zero.

10. Write an example places where you feel apparent weight loss or gain?

(i) Roller coaster

(ii) On a swing

(iii) In a vertical giant wheel

(iv) Lift

11. Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high velocity.

When large amount of water is ejected from a hose at a high velocity, according to Newton's Third Law of Motion, water pushes the hose in backward direction with the same force. Therefore, it is difficult for a fireman to hold a hose in which ejects large amount of water at a high velocity.

12. Calculate the force needed to speed up a car with a rate of $5ms^{-2}$, if the mass of the car is 1000 kg.

Acceleration = a = 5 ms^{-2}

Mass = m = 1000 kg

Force = F = ma = 1000 × 5 = 5000 $kgms^{-2}$

F = 5000 N

13. Convert 980 N into CGS unit?

F = 98 N

In CGS system, 1 Newton = 10^5 *dyne*

98 Newton = 98 × 10^5 *dyne*

F = 98 × 10^5 *dyne*

14. Calculate the mass of a moving body whose velocity is 0.5 ms^{-1} and linear momentum is 2.5 $kgms^{-1}$.

Velocity = v = 0.5 ms^{-1}

Momentum = p = 2.5 $kgms^{-1}$

Linear Momentum p = mv ⇒ m = P/v = 2.5/0.5 = 25/5 = 5 kg.

15. A 98 kg man stands on a scale in an elevator. When the elevator begins to rise, the scale reads 120 kg. What was the acceleration of lift? (Consider g = 9.8 m s^{-1})

Let 'a' be the acceleration of the lift

'm' be the mass of the person

'g' be the acceleration due to gravity

Weight of the person at rest = mg = 98

m = 98/g = 98/9.8 = 10 kg

Apparent weight of the person when the elevator is moving up is,

R = mg + ma = 120 kg

120 = 98 + 10a ⇒ 10a = 120-98 = 22

a = 22/10 = 2.2 ms^{-1}

∴ acceleration of the lift is 2.2 ms^{-1}

16. Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 m/s and 1 m/s, respectively. They collide and after the collision, the first object moves at a velocity of 1.67 m/s. Determine the velocity of the second object.

Given data

Let Mass of first object = m_1 = 100g

Initial Velocity of first object = u_1 = 2 m/s

Final Velocity of first object = v_1 = 1.67 m/s

Mass of second object = m_2 = 200g

Initial Velocity of second object = u_2 = 1 m/s

Final Velocity of second object = v_2

Solution

By law of conservation of momentum, after collision,

Sum of momentum after collision = Sum of momentum before collision

$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$

$100 \times 1.67 + 200v_2 = 100 \times 2 + 200 \times 1$

$200v_2 = 200 + 200 - 167 = 233$

$v_2 = 233/200 = 1.165$ m/s

∴ Velocity of the second object is 1.165 m/s.

II. Long answer questions :

1. Explain about Aristotle and Galileo statement of force?

Aristotle

- A moving body naturally comes to rest without any external influence of the force is natural motion (Force independent)
- A force is needed to make the bodies to move from their natural state and behave contrary to their own natural state as violent motion (Force dependent)
- The two different bodies are dropped from a height, the heavier body falls faster than the lighter one.

Galileo

- The natural state of all earthly bodies is either the state of rest or the state of uniform motion.
- A body is motion will continue to be in the same state of motion as long as no external force is applied.
- When a force is applied on bodies, they resist any change in their state.
- When dropped from a height in vacuum, bodies of different size, shape and mass fall at the same rate and reach the ground at the same time.

2. State and explain Newton's third law with example?

Newton's third law:

For every action, there is an equal and opposite reaction. They always act on two different bodies.

Examples:

1. when birds fly they push the air downwards with their wings (action) and the air pushes the birds upwards (Reaction)
2. When a person swims he pushes the water using the hands backwards (action) and the water pushes the swimmer in the forward direction (Reaction)
3. When you fire a bullet, the gun recoils backward and the bullet is moving forward (action) and the gun equalizes this forward action by moving backward (Reaction).

3. Derive the relation between g and G.

Let M be the mass of the Earth and m be the mass of the body.

The entire mass of the Earth is assumed to be concentrated at its centre.

By newton's law of gravitation

$$F = \frac{GMm}{R^2} \quad \text{.....(1)}$$

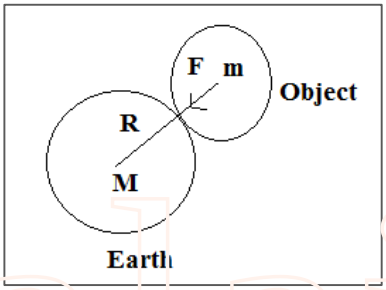
From Newton's second law

$$F = ma = mg \quad \text{..... (2)}$$

(1) = (2) Comparing equation (1) and (2)

$$mg = \frac{GMm}{R^2} \Rightarrow g = \frac{GM}{R^2}$$

Acceleration due to gravity $g = \frac{GM}{R^2}$



4. Write the Applications of torque.

Gears	❖ A gear is a circular wheel with teeth around its rim. ❖ It helps to change the speed of rotation of wheel by changing the torque and helps to transmit power.
Sea saw	❖ Since there is a difference in the weight of the persons sitting on it, the heavier person lifts the lighter person. ❖ When the heavier person comes closer to the pivot point the distance of the line of action of the force decreases. ❖ It causes less amount of torque to act on it. This enables the lighter person to lift the heavier person.
Steering wheel	❖ A small steering wheel enables you to manoeuore a car easily by transferring a torque to the wheels with less effort.

5. Illustrate the apparent weight concept with an example.

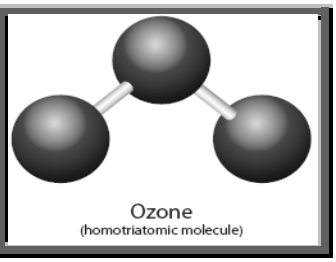
❖ **Apparent weight** is the weight of the body acquired due to the action of gravity and other external forces acting on the body

❖ **Illustration:**

Consider a person of mass 'm' travelling in a lift.

The apparent weight (R) of the person varies based on the motion of the lift – upwards or downwards.

UNIT - 7
ATOMS AND MOLECULES



POINTS TO REMEMBER

Atom	The **definition** of an **atom** is the smallest component of an element, characterized by a sharing of the chemical properties of the element and a nucleus with neutrons, protons and electrons.
Isotopes	Atoms of different elements having the same atomic number, but different mass number are called **Isotopes**. ($_{17}Cl^{35}$, $_{17}Cl^{37}$)
Isobar	Atoms of different elements having the same mass number, but different atomic number are called **Isobar** ($_{18}Ar^{40}$, $_{20}Ca^{40}$).
Isotones	Atoms of different elements having the same number of neutron, but different atomic number and different mass number are called **Isotones** ($_{6}C^{13}$, $_{7}N^{14}$).
Relative atomic mass	**Relative atomic mass** of an elements is the ratio between the mass of one atom of the element to $^{1}/_{12}{}^{th}$ of the mass of the atom of Carbon 12.
Average atomic mass	**Average atomic mass** of an elements is calculated by adding the masses of its isotopes, each multiplied by their natural abundance on the earth.
Relative molecular mass	Relative molecular mass of a molecule is the ratio between the mass of one molecule of the substance to $^{1}/_{12}{}^{th}$ of the mass of the atom of Carbon−12.
Avogadro's law	The Avogadro's law states that "equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules".
Vapour density	The vapour density is defined as "the ratio between the masses of equal volumes of a gas (or a vapour) and hydrogen under the same condition".
Atomicity	Atomicity of a monoatomic element = $\frac{\text{Molecular mass}}{\text{Atomic mas}}$
Atomic mass unit	The mass of an atom is measured in **atomic mass unit** (amu). In modern system, atomic mass unit (amu) is denoted a 'u'.
STP	STP – Standard Temperature and Pressure is 273.15 K, 1.00 atm.
Molar Volume	One mole of any gas occupies 22.4 liter or 22400 ml at S.T.P. This volume is called as molar volume.
Avogadro's law	"equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules"
Vapour density	"The ratio between the masses of equal volumes of a gas (or a vapour) and hydrogen under the same condition".

FORMULAE

- Calculation of number of mole by different modes.

  Number of moles $= \frac{\text{Mass}}{\text{Atomic mass}} = \frac{\text{Mass}}{\text{Molecular mass}}$

  $= \frac{\text{Number of Atoms}}{6.023\times10^{23}} = \frac{\text{Number of Molecules}}{6.023\times10^{23}}$

- Molecular mass $= 2 \times$ Vapour density
- Atomicity $= \frac{\text{Molecular mass}}{\text{Atomic mass}}$
- Relative Atomic mass $= \frac{\text{Average mass of the isotopes of the element}}{\frac{1}{12}\text{th of the mass of one Carbon}-12\text{ atom}}$

TEXTBOOK QUESTIONS

I. Choose the correct answer:

1. Which of the following has the smallest mass?
   a) 6.023×10^{23} atoms of He b) 1 atom of He **c) 2 g of He** d) 1 mole atoms of He
2. Which of the following is a triatomic molecule?
   a) Glucose b) Heliurn **c) Carbon dioxide** d) Hydrogen
3. The volume occupied by 4.4 g of CO_2 at S.T.P
   a) 22.4 litre **b) 2.24 litre** c) 0.24 litre d) 0.1 litre
4. Mass of 1 mole of Nitrogen atom is
   a) 28 amu **b) 14 amu** c) 28 g d) 14 g
5. Which of the following represents 1 amu?
   a) Mass of a C – 12 atom b) Mass of a hydrogen atom
   c) 1/12th of the mass of a C – 12 atom d) Mass of O – 16 atom
6. Which of the following statement is incorrect?
   a) One gram of C – 12 contains Avogadro's number of atoms.
   b) One mole of oxygen gas contains Avogadro's number of molecules.
   c) One mole of hydrogen gas contains Avogadro's number of atoms.
   d) One mole of electrons stands for 6.023×10^{23} electrons.
7. The volume occupied by 1 mole of a diatomic gas at S.T.P is
   a) 11.2 litre b) 5.6 litre **c) 22.4 litre** d) 44.8 litre
8. In the nucleus of $_{20}Ca^{40}$, there are
   a) 20 protons and 40 neutrons **b) 20 protons and 20 neutrons**
   c) 20 protons and 40 electrons d) 40 protons and 20 electrons
9. The gram molecular mass of oxygen molecule is
   a) 16 g b) 18 g c) 32 g d) 17 g
10. 1 mole of any substance contains ____molecules.
    a) 6.023×10^{23} b) 6.023×10^{-23} c) 3.0115×10^{23} d) 12.046×10^{23}

II. Fill in the blanks

1. Atoms of different elements having **same** mass number, but **different** atomic numbers are called isobars.
2. Atoms of different elements having same number of **neutrons** are called isotones.
3. Atoms of one element can be transmuted into atoms of other element by **discovery of artificial transmutation**.
4. The sum of the numbers of protons and neutrons of an atom is called its **mass number**.
5. Relative atomic mass is otherwise known as **Standard atomic weight**.
6. The average atomic mass of hydrogen is **1.008** amu.
7. If a molecule is made of similar kind of atoms, then it is called **homoatomic molecule**.
8. The number of atoms present in a molecule is called its **atomicity**.
9. One mole of any gas occupies **22400** ml at S.T.P.
10. Atomicity of phosphorous is **4**.

III. Match the following

1. 8g of O_2	4 moles
2. 4g of H_2	0.25 moles
3. 52 g of He	2 moles
4. 112 g of N_2	0.5 moles
5. 35.5 g of Cl_2	13 moles

Answer
1) 0.25 moles
2) 2 moles
3) 13 moles
4) 4 moles
5) 0.5 mole

IV. True or False: (if false give the correct statement)

1.	Two elements sometimes can form more than one compound.	**True**
2.	Noble gases are Diatomic. *(**Correct statement** : Noble gases are **monoatomic** molecule.)*	**False**
3.	The gram atomic mass of an element has no unit. *(**Correct statement** : Atomic mass of an elements is expressed in **grams**.)*	**False**
4.	1 mole of Gold and Silver contain same number of atoms.	**True**
5.	Molar mass of CO2 is 42g. (***Correct statement*** : Molar mass of Co_2 is **44 g**.)	**False**

V. Assertion & Reasoning :

Answer the following questions using the data given below:

i) A and R are correct, R explains the A.
ii) A is correct, R is wrong.
iii) A is wrong, R is correct.
iv) A and R are correct, R does not explains A.

1. **Assertion:** Atomic mass of aluminium is 27
   Reason : An atom of aluminium is 27 times heavier than 1/12th of the mass of the C – 12 atom.

   Ans. (i) ***A and R are correct, R explains the A.***

2. Assertion: The Relative Molecular Mass of Chlorine is 35.5 a.m.
Reason : The natural abundance of Chlorine isotopes are not equal.

Ans. (ii) ***A is correct, R is wrong.***

VI. Short Answer questions:

1. Define: Relative atomic mass.

Relative atomic mass of an element is the ratio between the average mass of its isotope to $1/12^{th}$ part of the mass of a carbon-12 atom.

Relative atomic mass $A_r = \frac{\text{Average mass of the isotopes of the element}}{{}^{1}/_{12}\text{th of the mass of one carbon 12 atom}}$

2. Write the different types of isotopes of oxygen and its percentage abundance.

Isotope	Mass (amu)	% abundance
${}_8O^{16}$	15.9949	99.757
${}_8O^{17}$	16.9991	0.038
${}_8O^{18}$	17.9992	0.205

The atomic mass of oxygen = (15.9949 × 0.99757) + (16.9991 × 0.00038) + (17.9992 × 0.00205)
= 15.999 amu.

3. Define: Atomicity.

Atomicity - The number of atoms present in the molecule is called atomicity.

4. Give any two examples for heterodiatomic molecules.

HCl, HF – Heterodiatomic molecules.

5. What is Molar volume of a gas?

Molar volume of a gas: One mole of any gas occupies 22.4 litre (or) 22400 ml at STP. This volume is called Molar Volume.

6. Find the percentage of nitrogen in ammonia.
(N-14, H-1)

Molar mass of NH_3 = 14 +3 = 17 g

Mass % of Nitrogen = $\frac{14}{17} \times 100$ = 82.35 %

VII. Long Answer questions:

1. Calculate the number of water molecule present in one drop of water, which weighs 0.18 g.

Number of molecules = $\frac{\text{Avogadro number} \times \text{mass of water}}{\text{Gram molecular mass}}$

= $\frac{6.023 \times 10^{23} \times 0.18}{18}$ = 0.06023×10^{23}

The no of water molecules = 6.023×10^{25}.

2. $N_2 + 3\ H_2 \rightarrow 2\ NH_3$

(The atomic mass of nitrogen is 14, and that of hydrogen is 1)

1 mole of nitrogen (__g) + 3 moles of hydrogen (__ g) → 2 moles of ammonia (__ g)

(The atomic mass of N is 14 and that of hydrogen is 1)

$N_2 + 3\ H_2 \rightarrow 2\ NH_3$ (N = 14, H = 1)

1 mole of nitrogen **(28g)** + 3 moles of hydrogen **(6g)** → 2 moles of ammonia **(34 g)**

3. Calculate the number of moles in i) 27g of Al ii) 1.51×10^{23} molecules of NH_4Cl

i) 27g of Al:

$$\text{Number of moles} = \frac{\text{Mass of Al}}{\text{Atomic mass of Al}}$$

$$= \frac{27}{27} = 1 \text{ mole.}$$

ii) 1.51×10^{23} molecules of NH_4Cl :

Molecular mass of NH_4Cl = 53.5 g

$$\text{Number of mole} = \frac{\text{Number of Molecules}}{\text{Avogador's number}}$$

$$= \frac{1.51 \times 10^{23}}{6.023 \times 10^{23}} = \frac{1}{4}$$

$$= 0.25 \text{ mole.}$$

$$\text{Mass} = \text{mole} \times \text{molecular mass}$$

$$= 0.25 \times 53.5 \quad = 13.375 \text{ g.}$$

Molecular mass of **NH_4Cl**

N	14
H	4
Cl	35.5
Total	**53.5**

4. Give the salient features of "Modern atomic theory".

- An atom is no longer indivisible (after the discovery of electron; Proton and neutron)
- Atoms of the same element may have different atomic mass (isotopes $_{17}Cl^{35}$, $_{17}Cl^{37}$)
- Atoms of different elements may have same atomic masses (isobars $_{18}Ar^{40}$, $_{20}Ca^{40}$).
- Atom of one element can be transmitted into atoms of other elements. In other words, atom is no longer in destructive (artificial transmutation).
- Atoms may not always combine in a simple whole number ratio. (Eg: Glucose. $C_{16}H_{12}O_6$ C:H:O = 6:12:6 or 1:2:1).
- Atom is the smallest particle that takes part in a chemical reaction.
- The mass of an atom can be converted into energy. ($E = mc^2$)

5. Derive the relationship between Relative molecular mass and Vapour density.

(i) Relative Molecular Mass (Hydrogen scale)

The Relative Molecular Mass of a gas is the ratio between the mass of one molecular of the gas of one atom of Hydrogen

(ii) Vapour Density:

Vapour density is the ratio of the mass of a certain volume of a gas or vapour to the mass of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.

$$\text{Vapour density (V.D)} = \frac{\text{mass of a given volume of gas (or) vapour at STP}}{\text{mass of the same volume of Hydrogen}}$$

According to Avogadro's law

$$\text{Vapour Density (at STP)} = \frac{\text{mass of n molecules of a gas (or) vapour at STP}}{\text{mass of n molecules of hydrogen}}$$

Hydrogen is diatomic molecule so,

$$\text{Vapour Density} = \frac{\text{mass of 1 molecule of gas (or)vapour at STP}}{2 \times \text{mass of 1 atom of hydrogen}}$$

$$2 \times \text{Vapor density} = \frac{\text{Massof 1 molecule of a gas or vapour at STP}}{\text{masss of 1 atom of hydrogen}}$$

$$2 \times \text{Vapour density} = \text{Relative molecular mass of a gas.}$$

$$\text{Relative molecular mass} = 2 \times \text{Vapour density.}$$

VIII. HOT Questions:

1. Calcium carbonate is decomposed on heating in the following reaction

$$CaCO_3 \rightarrow CaO + CO_2$$

i) How many moles of Calcium carbonate are involved in this reaction?

One mole of $CaCo_3$ is involved in the reaction.

ii) Calculate the gram molecular mass of calcium carbonate involved in this reaction?

Gram molecular mass of $CaCo_3$ is 100g

$CaCo_3$ (Ca = 40, C = 12, O =16)

= 1× Ca + 1×C + 3× O

= 1 × 40 + 1×12+3×16

= 40 + 12 + 48 = 100

One mole of $CaCO_3$ is involved in the reaction

Therefore Molecular mass of $CaCo_3$ is = 1 × 100g = 100g.

iii. How many moles of CO_2 are there in this equation?

One mole of Co_2 is involved in this reaction.

IX. Solve the given problems

1. How many grams are there in the following?

i) 2 moles of hydrogen molecule, H_2

$$\text{Number of moles} = \frac{\text{mass}}{\text{Molecular mass}}$$

$$2 \text{ moles} = \frac{\text{mass}}{\text{molecular mass of Hydrogen}} = \frac{\text{mass}}{2}$$

Mass = 2 × 2 = 4g

ii) 3 moles of chlorine molecule, Cl_2

$$3 \text{ moles} = \frac{\text{Mass}}{\text{Molecular mass of } Cl_2} = \frac{\text{Mass}}{71}$$

Mass = 71 × 3 = 213 g.

iii) 5 moles of sulphur molecule, S_8

$$5 \text{ moles} = \frac{\text{Mass}}{\text{Molecular mass of } S_8} = \frac{\text{Mass}}{256}$$

Mass = 5 × 256 = 1280 g.

iv) 4 moles of phosphorous molecule, P_4

$$4 \text{ moles} = \frac{\text{Mass}}{\text{Molecular mass}} = \frac{\text{Mass}}{120}$$

Mass = 120 × 4 = 480g

2. Calculate the % of each element in calcium carbonate. (Atomic mass: C -12, O -16,Ca - 40)

Elements	Atomic mass	$\frac{\text{Atomic mass}}{\text{Molecular mass}} \times 100$	Percentage %
Ca	40	$\frac{40}{100} \times 100$	40%
C	12	$\frac{12}{100} \times 100$	12%
O	48 (3×16 = 48)	$\frac{48}{100} \times 100$	48%

3. Calculate the % of oxygen in $Al_2(SO_4)_3$. (Atomic mass: Al -12, O -16, S - 32).

$Al_2(SO_4)_3$

$(2 \times Al + 3 \times S + 12 \times O) = 2 \times 27 + 3 \times 32 + 12 \times 16$

$= 54 + 96 + 192 \quad = 342$ g

% of O in $Al_2(SO_4)_3$ $= \frac{192}{342} \times 100 \quad = 56.14\%$

4. Calculate the % relative abundance of B -10 and B -11, if its average atomic mass is 10.804 amu.

Average atomic mass of B = 10.804 amu

$m_1 = 10$
$m_2 = 11$

Average atomic mass $= \frac{a_1 m_1 + a_2 m_2}{a_1 + a_2}$

10.804 amu $= \frac{a_1 \times 10 + a_2 \times 11}{a_1 \times a_2}$

$a_1 = 100 - a_2 \quad (\because a_1 + a_2 = 100)$

$10.840 \text{ amu} = \frac{(100 - a_2) \times 10 + a_2 \times 11}{100}$

$1080.4 = \frac{1000 - 10a_2 + 11a_2}{100}$

$10.804 = 1000 + a_2$

$a_2 = -1000 + 1080.4 = 80.4\%$

$a_1 + a_2 = 100$

$a_1 + 80.4 = 100$

$a_1 = 100 - 80.4 = 19.6\ \%$

∴ % abundance of B-10 = 19.6 %

% abundance of B-11 = 80.4%

ADDITIONAL QUESTIONS

I. Choose the correct answer:

1. Which one of the following has the highest gram molecular mass
   (a) H_2O **(b) Co_2** (c) NH_3 (d) HCl.
2. Which of the following is a heteroatomic molecule
   (a) H_2 (b) N_2 (c) O_2 **(d) HCl**
3. One molar volume of NH_3 gas occupies
   (a) 2.24 litre **(b) 22.4 litre** (c) 224 litre (d) 0.224 litre.
4. Molar mass of H_2SO_4 is
   (a) 9.8 g **(b) 98 g** (c) 0.98 g (d) 0.098 g
5. Atomicity of Ozone is
   (a) 1 (b) 2 **(c) 3** (d) 4
6. In the nucleus of $_{15}P^{31}$ contains
   (a) 15 Proton 16 neutron (b) 15 Proton 15 neutron
   (c) 31 Proton 31 neutron (d) 15 Proton 31 31 neutron.
7. Mass percentage composition of Carbon in methane
   (a) 75 % (b) 60 % (c) 90 % (d) 25 %

8. The number of molecules in 36 g H_2O is
(a) 12.046×10^{23} (b) 6.023×10^{23} (c) 18.069×10^{23} (d) 3.011×10^{23}
9. The number of molecules in 11.2 litre of Co_2 at STP
(a) 1 mole (b) 2 moles (c) 3 moles **(d) 0.5 mole**
10. The atomic mass is denoted in the modern system
(a) U **(b) 'u'** (c) Au (d) Am

II. Fill in the blanks:

1. The standard temperature and pressure is **273.15 K , 1.00 atm**.
2. The number of one mole of atoms is **6.023×10^{23}**.
3. The number of one mole of molecules is **6.023×10^{23}.**
4. Gram molecular mass of HCl is **36.5 g**.
5. An example of polyatomic molecule is **$C_6H_{12}O_6$**.
6. The isotopes of Hydrogen are **$_1H^1$, $_1H^2$, $_1H^3$**.
7. The Average of atomic mass of oxygen is **15.999 amu**.
8. Standard Molar Volume at STP is **22.4 litres**.
9. The molecular mass of $Ca(Po_4)_2$ is **308 g**.
10. 3. 0115 $\times 10^{23}$ molecules of water is **0.5** mole.

III. Match the following:

1. 128 g of O_2	0.5 mole
2. 17 g of NH_3	4 moles
3. 160 g of CH_4	2 moles
4. 50 g of $CaCo_3$	1 mole
5. 71 g of Cl_2	10 moles

Answer
1) 4 moles
2) 1 mole
3) 10 moles
4) 0.5 mole
5) 2 moles

IV. True or False: (if false give the correct statement):

1.	One mole of Nitrogen (N_2) gas contains Avogadro number atoms. ***(Correct statement :** One mole of Nitrogen gas contains Avogadro number of **molecules**.)*	**False**
2.	The sum of the number of Protons and neutron of an atom is called it mass number.	**True**
3.	Standard atom weight is denoted as Ar.	**True**
4.	Atoms of different elements having the same mass number but different atomic number are called Isotones. ***(Correct statement :** Atoms of different elements having the same mass number but different atomic number are called **Isobar**)*	**False**

V. Assertion & Reasoning:

(a) A and R are correct R explains the A.
(b) A is correct and R is wrong.
(c) A is wrong and R is correct.
(d) A and R are correct, R does not explains A

1. **Assertion:** The relative molecular mass of oxygen is 15.99 amu
   Reason : The natural abundance of oxygen isotopes are $_8O^{16}$ = 99.757 % , $_8O^{17}$ = 0.038 %
   Ans. (a) ***A and R are correct R explains the A.***
2. **Assertion:** Relative atomic mass of an element is the ration between the average mass of its isotopes to $^1/_{12}\,th$ part of the mass of C-12 atom.
   Reason : In modern method, C-12 is used as standard.
   Ans. (a) ***A and R are correct R explains the A.***

VI. Short answer questions:

1. **What are Isotopes?**
   - Atoms of the same elements may have different atomic mass called Isotopes
   - **Example:** $_{17}Cl^{35}$, $_{17}Cl^{37}$
2. **What are Isobars?**
   - Atoms of different elements may have same atomic masses are called Isobars.
   - **Example:** $_{18}Ar^{40}$, $_{20}Ca^{40}$.
3. **What are Isotones?**
   - Atoms of different elements having the same number of neutrons, but different atomic number and different mass number are called Isotones.
   - **Example:** $_6C^{13}$, $_7N^{14}$
4. **What is artificial transmutation?**
   - Atoms of one element can be transmuted into atoms of other elements. In other words, atom is no longer indestructible is known as artificial transmutation.
5. **What is Average Atomic Mass (AAM)?**
   The average atomic mass of an element is the weighted average of the masses of its naturally occurring isotopes.
6. **Define Standard atomic weight.**
   - Relative atomic mass of an element is the ratio between the average mass of its Isotopes to $\frac{1}{12}^{th}$ part of the mass of a carbon-12 atom.
   - It is denoted as A. It is otherwise called "Standard Atomic Weight".
7. **Define Gram molecular mass.**
   - Relative molecular mass is only a ratio. So it has no unit.
   - If the molecular mass of a compound is expressed in grams, then it is Gram molecular mass.
8. **What is Avogadro's number?**
   The mole of substance that contains, as many elementary entities (atoms, molecules or other particles) as there are atoms in 12g of carbon-12 isotopes is called Avogadro's Number (N_A). Its value is 6.023×10^{23}.
9. **Define Mole concept.**
   The study of the collection of particles by using mole as the counting unit, in order to express the mass and volume of such unit particles in a bulk matter is known as mole concept.
10. **What is Avogadro's Hypothesis?**
    The Avogadro's law states that "equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules".

VII. Long Answer questions:

1. Calculate the number of Ammonia molecules present in 44.8 litres of ammonia gas?

Number of mole of NH_3 $= \frac{\text{Volume at STP}}{\text{Molar Volume}}$

$= \frac{44.8}{22.4} = 2$ moles

Number of molecules of NH_3 = Number of moles of NH_3 × Avogadro's number

$= 2 \times 6.023 \times 10^{23}$

$= 12.046 \times 10^{23}$ of NH_3.

$= 12.046 \times 10^{23}$ molecules of Ammonium gas.

2. Calculate the number of moles of the following (i) 44 g Co_2 (ii) 12. 046 × 10^{23} atoms of Al (iii) 400 g of $CaCo_3$ (iv) 44.8 litre of NH_3.

(i) 44 g Co_2: Number of moles $= \frac{\text{Mass of Compound}}{\text{Molecular Mass}}$ $= \frac{44}{44}$ = 1 mole.	**(ii) 12. 046 × 10^{23} atoms of Al:** Number of moles $= \frac{\text{Number of atoms of Al}}{\text{Avogadro's number}}$ $= \frac{12.046 \times 10^{23}}{6.023 \times 10^{23}}$ = 2 moles.
(iii) 400 g of $CaCo_3$: Number of moles $= \frac{\text{Mass of Compound}}{\text{Molecular Mass}}$ $= \frac{400}{100}$ = 4 moles.	**(iv) 44.8 litre of NH_3 gas:** Number of moles $= \frac{\text{given volume of } NH_3 \text{ at STP}}{\text{Molar Volume}}$ $= \frac{44.8}{22.4}$ = 2 moles.

3. Distinguish between atoms and molecules.

Atom	Molecule
(i) An atom is the smallest particle of an element.	(i) A molecule is the smallest particle of an element or compound
(ii)Atom does not exist in free state except in a noble gas.	(ii) Molecule exists in free state.
(iii)Except some of noble gas, other atoms are highly reactive.	(iii) Molecules are less reactive.
(iv) Atom does not have a chemical bond.	(iv) Atoms in a molecule are held by chemical bonds.

4. Define various concept of mole:

The number of moles of a substance can be calculated by various means depending on the data available as follows.

- Number of moles of molecules.
- Number of moles of atoms.
- Number of moles of a gas(Molar Volume at STP = 22.4 litre)
- Number of moles of ions.
- STP – Standard Temperature and Pressure. 273.15 K at 1.00 atm.

Mole of atom :

One mole of an element contain 6.023×10^{23} atoms and it is equal to its gram atomic mass.

One mole of oxygen contains 6.023×10^{23} atoms of oxygen and its gram atomic mass is 16 g.

Mole of Molecules :

One mole of matter contains 6.023×10^{23} molecules and it is equal to its gram molecular mass.

One mole of oxygen contains 6.023×10^{23} molecules of oxygen its gram moleculer mass is 32 g.

Molar Volume :

One mole of any gas occupies 22.4 litre or 2240 ml at STP. This volume is called as molar volume.

5. **$H_2 + I_2 \leftrightharpoons 2HI$, Calculate the number of moles participated in this reaction. The atomic mass of Hydrogen is 1, Iodine is 127)**

1 mole of Hydrogen (2 gram) + 1 mole of Iodine (254 gram) + 2 moles of Hydrogen Iodine **256 gram.**

VIII. HOT Questions :

1. **$PCl_5 \leftrightharpoons PCl_3 + Cl_2$ is a decomposition reaction,**

(i) How many mole of PCl_5 involved in the reaction?

1 mole of PCl_5 is involved.

(ii) Calculated the gram molecular mass of PCl_5

$= 1\times P + 5 \times Cl$ (P = 31, Cl = 35.5)

$= 1\times 31 + 5 \times 35.5$

$= 31 + 178$

$= 209$ grams.

(iii) How many moles of Cl_2 gas evolved during the reaction?

One mole of cl_2 gas is involved.

IX. Solve the given problems

1. Calculate the % of oxygen in $CaCo_3$ (atomic mass Ca−40, C−12, O−16)

Molecular mass of $CaCo_3$ $= 1\times Ca + 1 \times C + 3 \times O$

$= 1\times 40 + 1 \times 12 + 3 \times 16$

$= 40+12+48$

$= 100$ g.

Mass % of Oxygen is $= \frac{16}{100} \times 100 = 16$ %.

2. Calculate the % of oxygen in NaOH (Na−23, O−16, H−1)

Molecular mass $= 1\times Na + 1 \times O + 1 \times H$

$= 1\times 23 + 1 \times 16 + 1 \times 1$

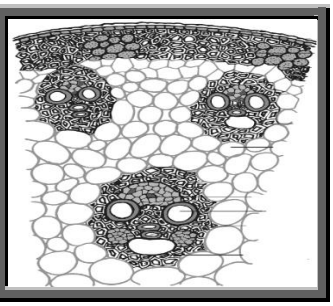
$= 23 + 16 + 1$

$= 40$

Mass of percentage of oxygen is $= \frac{16}{40} \times 100$

Mass Percentage of oxygen $= 40$ %.

UNIT - 12
PLANT ANATOMY AND PLANT PHYSIOLOGY



POINTS TO REMEMBER

Plant Anatomy	Plant Anatomy is the study of internal structure of plants.
Tissues	Tissues are the group of cells that are similar or dissimilar in structure and origin.
Types of Tissues	They are two types of tissues 1) Meristamatic Tissue 2) Permanent Tissue.
Tissue System	Sachs in 1875, classified tissue system in plants into three types 1) Dermal or Epidermal tissue system 2) Ground tissue system 3) Vascular tissue system.
Xylem	Conducts water and minerals to different parts of the plant.
Phloem	Conducts food materials to different parts of the plant.
Concentric vascular bundle	Vascular bundle in which xylem completely surrounds the phloem or vice versa is called concentric vascular bundle.
Endarch	Protoxylem lies towards the centre and metaxylem lies towards the periphery. ***e.g.*** stem.
Exarch	Protoxylem lies towards the periphery and metaxylem lies towards the centre. ***e.g.*** roots.
Conjunctive tissue	The tissue present between xylem and phloem is called conjunctive tissue.
Pericycle	It occurs between vascular bundle and endodermis.
Pith	The large central parenchymatous zone with intercellular spaces is called pith.
Mesophyll	The tissue present between the upper and lower epidermis is called mesophyll.
Plastids	Plastids are double membrane bound organelles found in plants and some algae. They are responsible for preparation and storage of food.
Photo synthesis	The process of carbon dioxide combines with water in the presence of sunlight and chlorophyll to form carbohydrates.
Mitochondria	These are organelles within eukaryotic cells that produce ATP which form the energy currency of the cell, for this reason if is referred to as “the power house of the cell”.
Respiration	The plants obtain oxygen from their environment and release carbon dioxide and water vapour. There are two types of Respiration. 1) Aerobic Respiration 2)Anaerobic Respiration

TEXTBOOK QUESTIONS

I. Choose the correct answer:

1. Casparian strips are present in the _____ of the root
   a) Cortex b) Pith c) Pericycle **d) endodermis**
2. The endarch condition is the characteristic feature of
   a) root **b) Stem** c) leaves d) flower
3. The xylem and phloem arranged side-by-side on same radius is called
   a) radial b) amphivasal **c) conjoint** d) None of these
4. Which is formed during anaerobic respiration
   a) Carbohydrate **b) Ethyl alcohol** c) Acetyl CoA d) pyruvate
5. Kreb's cycle takes place in
   a) chloroplast **b) mitochondrial matrix**
   c) stomata d) inner mitochondrial membrane
6. Oxygen is produced at what point during photosynthesis
   a) when ATP is converted to ADP b) when Co_2
   c) when H_2O is splitted d) All of these

II. Fill in the blanks:

1. Cortex lies between **epidermis and vascular tissues.**
2. Xylem and phloem occurring on the same radius constitute a vascular bundle called **conjoint bundle**.
3. Glycolysis takes place in **cytoplasm**.
3. The source of O_2 liberated in photosynthesis is **water**.
4. **Mitochondria** is the ATP factory of the cells.

III. State whether the following statements are true or false. Correct the statement if it is false:

1.	Phloem tissue is involved in the transport of water in plant. ***(corrected Statement: Xylem** tissue is involved in the transport of water in plant)*	**False**
2.	The waxy protective covering of a plant is called as cuticle.	**True**
3.	In monocot, stem cambium is present in between the xylem and phloem. ***(corrected Statement:** In **dicot** stem cambium is **present** in between the xylem and phloem)*	**False**
4.	Palisade parenchyma cells occur below upper epidermis in dicot root. ***(Corrected Statement :** Palisade parenchyma cells occur below upper epidermis in **dicot leaf**)*	**False**
5.	Mesophyll contains chlorophyll.	**True**
6.	Anaerobic respiration produces more ATP than aerobic respiration. ***(Corrected Statement:** Anaerobic respiration produces **less ATP** than aerobic respiration)*	**False**

IV. Match the following:

Column I	Column II
1. Ambhicribal	Dracaena
2. Cambium	Translocation of food
3. Amphivasal	Fern
4. Xylem	Secondary growth
5. Phloem	Conduction of water

Answer
1. Fern
2. Secondary growth
3. Dracaena
4. Conduction of water
5. Translocation of food

V. Answer in a sentence:

1. What is collateral vascular bundle?

Xylem lies towards the centre and phloem lies towards the periphery.

2. Where does the carbon that is used in photosynthesis come from?

From atmosphere, carbon is absorbed in the form of carbon dioxide, and this carbon is used in photosynthesis to prepare carbohydrates.

3. What is the common step is aerobic and anaerobic path way?

Glycolysis is the common step in aerobic and anaerobic path way.

4. Name the phenomenon by which carbohydrates are oxidized to release ethyl alcohol.

- ❖ Anaerobic respiration. It takes place without oxygen.
- ❖ Glucose (or) carbohydrate are oxidized to release ethyl alcohol.

VI. Short answer Questions:

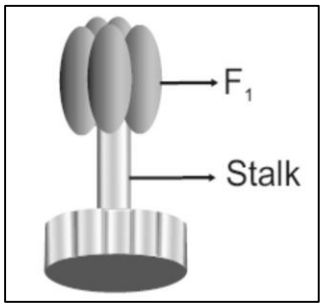
1. Give an account on vascular bundle of dicot stem.

- ❖ Vascular bundles of dicot stem are conjoint collateral, endarch and open.
- ❖ They are arranged in the form of a ring around the pith.

2. Write a short note on mesophyll.

- ❖ In a leaf, the tissue present between the upper and lower epidermis is called mesophyll.
- ❖ It is differentiated into palisade parenchyma and Spongy parenchyma.

3. Draw and label the structure of oxysomes.



4. Name the three basic tissue system in flowering plants.

- ❖ Dermal (or) Epidermal tissue system
- ❖ Ground tissue system
- ❖ Vascular tissue system

5. What is photosynthesis and where in a cell does it occur?

- ❖ Photosynthesis is a process by which autotrophic organisms like green plants, algae and chlorophyll containing bacteria utilize the energy from sunlight to synthesize their own food.
- ❖ Photosynthesis occur in the chloroplast.

6. Why should the light dependent reaction occur before the light independent reaction?

- ❖ During light dependent reactions, the photosynthetic pigments absorb the light energy and convert it into chemical energy ATP and ANDPH$_2$.
- ❖ During light independent reactions, Co$_2$ is reduced into carbohydrates with the help of light generates ATP and NADPH$_2$. So light dependent reaction occur before the light independent reaction.

7. Write the reaction for photosynthesis.

$$6\,Co_2 + 12\,H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6\,H_2O + 6O_2\uparrow$$

VII. Long Answer Questions:

1. Differentiate the following.

a) Monocot root and Dicot root b) Aerobic and Anaerobic respiration

a) Monocot root and Dicot root:

Tissues	Dicot Root	Monocot Root
Number of Xylem	Tetrarch	Polyarch
Cambium	Present (During secondary growth only)	Absent
Secondary Growth	Present	Absent
Pith	Absent	present

b) Aerobic and Anaerobic respiration:

Aerobic respiration	Anaerobic respiration
Aerobic respiration takes place in the presence of oxygen.	Anaerobic respiration takes place in the absence of oxygen.
It occurs in most plants and animals	It occurs in some bacteria
Carbohydrate is completely oxidized into carbon dioxide, water and energy	Glucose is converted into ethanol (in plants) or lactate (in some bacteria)
$C_6H_{12}o_6 + 6o_2 \rightarrow 6C0_2 + 6H_2O + ATP$	$C_6H_{12}o_6 \rightarrow 2\,Co_2 + 2\,C_2H_5OH$ + Energy (ATP)

2. Describe and name three stages of cellular respiration that aerobic organisms use to obtain energy from glucose.

Glycolysis:

- ❖ It is the breakdown of one molecule of glucose (6 carbon) into two molecules of pyruvic acid (3 carbon).
- ❖ Glycolysis takes place in cytoplasm of the cell. It is the first step of both aerobic and anaerobic respiration.

Krebs cycle:

- This cycle occurs in mitochondria matrix.
- At the end of glycolysis, two molecules of pyruvic acid enter into mitochondria.
- The oxidation of pyruvic acid into CO_2 and water takes place through this cycle. It is also called Tricarboxylic Acid cycle (TCA).

Electron Transport chain:

- This is accomplished through a system of electron carrier complex called ETC (Electron Transport Chain) located on the inner membrane of the mitochondria.
- $NADH_2$ and $FADH_2$ molecules formed during glycolysis and Kreb's cycle are oxidised to NAD^+ and FAD^+ to release the energy via electrons.
- The electrons as they more through the system, release energy which is trapped by ADP to synthesize ATP.
- This process O_2 the ultimate acceptor of electrons gets reduced to water.

3. How does the light dependent reaction differ from the light independent reaction? What are the end product and reactants in each? Where does each reaction occur within the chloroplast?

Light dependent Reaction	Light independent Reaction
This reaction takes place in the presence of light energy in thylakoid membranes (grana) of the chloroplast	Light independent reaction is carried out in the stroma. It takes place in the absence of light.
Photosynthetic pigments absorb the light energy and convert it into chemical energy ATP and $NADPH_2$	During this reaction Co_2 is reduced into carbohydrates with the help of light generates ATP and a$NADPH_2$
The end products are ATP and $NADPH_2$ and o_2	End product is carbohydrate, ADP and NADP
The reactants are 3 chlorophyll, sunlight and water	The reactants are Co_2, ATP and $NADPH_2$.
It occurs in thylakoid membrane (grana) of the chloroplast.	It occurs in the stroma of the chloroplast.

VIII. Higher Order Thinking Skills (HOTS):

1. The reactions of photosynthesis make up a biochemical pathway.
A) What are the reactants and products for both light and dark reactions?
B) Explain how the biochemical pathway of photosynthesis recycles many of its own reactions and identify the recycled reactants.

A)

	Light Reaction	Dark Reaction
Reactants	Chlorophyll, sunlight and H_2O	Co_2, ATP and $NADPH_2$
Products	ATP, $NADPH_2$ and o_2	Carbohydrate ADP and NADP

B)

- ❖ During light dependent reaction, ATP and $NADPH_2$ are generated.
- ❖ ATP, $NADPH_2$ reduce carbon dioxide to carbohydrates and during the process, they are converted into ADP and NADP
- ❖ Then these ADP and NADP are sent back to the grana of chloroplast to form ATP and $NADPH_2$.
- ❖ Likewise, CO_2 from the atmosphere is fixed by CO_2 acceptor molecule RUBP. During continuous reactions, CO_2 is reduced to glucose, and the CO_2 acceptor (RUBP) is recycles, so that it can again help in CO_2 fixation.
- ❖ During light dependent reaction, water is split, and release oxygen as a byproduct. At the same time during dark reaction water is again released.
- ❖ Thus ATP, $NADPH_2$, water, RUBP (CO_2 acceptor molecules) are recycled during biochemical pathway of photosynthesis.

2. Where do the light dependent reaction and the Calvin cycle occur in the chloroplast?

- ❖ Light dependent reaction takes place in the thylakoid membranes (grana) of the chloroplast.
- ❖ Calvin cycle or Light independent reaction takes place in the stroma of the chloroplast

ADDITIONAL QUESTIONS

I. Choose the Correct answer:

1. All tissues inner to endodermis constitute
   a) Epidermis b) Endodermis **c) Stele** d) Pericycle
2. It is present at the center of the dicot stem
   a) Cortex **b) Pith** c) Vascular bundle d) Hypodermis
3. Y shaped xylem and Protoxylem lacuna are present in
   a) Monocot stem b) Dicot stem c) monocot root d) dicot root
4. Where does photosynthesis occur?
   a) Leaves b) stems c) Floral buds **d) All of them**
5. The inner mitochondrial membrane gives rise to finger like projections called
   a) Matrix **b) Cristae** c) oxysomes d) membrane

II. Fill in the blanks:

1. **Sachs** in 1875, classified tissue system in plants into three types.
2. In a vascular bundle, xylem surrounds phloem, is called **amphivasal**.
3. In Endodermis, casparian strips are band like thickening made of **suberin**.
4. **Leucoplasts** are colourless plastics.
5. Tricarboxylic Acid cycle is otherwise known as **Kreb's cycle**.

III. Assertion & Reasoning:

Mark the correct choice as

a) Reason is correct Assertion is incorrect
b) Reason is incorrect Assertion is correct
c) Both Reason and Assertion are correct
d) Both Reason and Assertion are incorrect

1. Assertion : Vascular bundle of leaf mid-rib is larger

Reason : In leaves, the vascular bundles are conjoint, collateral and closed, and each vascular bundle sheath.

Ans. (c) ***Both Reason and Assertion are correct***

2. Assertion : The inner mitochondrial membrane bear minute regularly spaced tennis racked shaped particles known as oxysomes.

Reason : They are otherwise known as F, particles, and they involve in ATP synthesis.

Ans. (c) ***Both Reason and Assertion are correct***

IV. Match the following:

Column I	Column II
1. Epiblema	Chlorophyll
2. Endodermis	Outer layer of a root
3. Hill Reaction	Inner layer of a root
4. Primary pigment	Anaerobic respiration
5. Fermentation	Light dependent Reaction

Answer
1. Outer layer of a root
2. Inner layer of a root
3. Light dependent Reaction
4. Chlorophyll
5. Anaerobic respiration

V. Short answer questions:

1. Define – Bicollateral

In this type of bundle the phloem is present on both outer and inner side of xylem.
Eg: cucurbita

2. What is starch sheath?

In root, single layer of barrel shaped cells are seen in the inner most layer and, it is called as endodermis, it stores starch grains. So endodermis is also know as starch sheath.

3. Differentiate Palisade parenchyma and Spongy parenchyma

Palisade Parenchyma	Spongy Parenchyma
It is found just below the upper epidermis.	It is found below the palisade parenchyma tissue.
Cells are elongated, the do not have intercellular space	Cells are almost oval or spherical and are irregularly arranged.
They take past in photosynthesis	The cells have intercellular spaces, it helps in gaseous exchange.

4. Differentiate between Dicot and Monocot leaf.

Dicot Leaf	Monocot Leaf
Dorsiventral leaf	Isobilateral leaf
Mesophyll is differentiated into palisade and spongy parenchyma.	Mesophyll is not differentiated into palisade and spongy parenchyma.

5. Write the three types of plastids.

- Chloroplast → Green coloured plastids
- Chromoplast → Yellow, red, orange coloured plastids
- Leucoplast → Colourless plastids

6. Write down the functions of chloroplast

- Photosynthesis
- Storage of starch
- Synthesis of fatty acids.
- Storage of lipids.

7. What are the factors affecting photosynthesis

- External factors → Light, Co_2, temperature, water and mineral elements.
- Internal factors → Pigments, leaf age, accumulation of carbohydrates and hormones.

8. What is R.Q?

Respiratory Quotient is also know R.Q. It is the ratio of volume of carbon dioxide liberates and the volume of oxygen consumed during respiration

$$RQ = \frac{\text{volume of } Co_2 \text{ liberated}}{\text{volume of } o_2 \text{consumed}}$$

VI. Answer in Details:

1. Explain, different types of vascular bundles with diagram.

Vascular Tissue System:

- It consists of xylem and phloem tissues.
- They are present in the form of bundles called vascular bundles.
- Xylem conducts water and minerals to different parts of the plant.
- Phloem conducts food materials to different parts of the plant.
- There are three different types of vascular bundles namely

(i) Radial (ii) Conjoint (iii) Concentric

(i) Radial Bundles:

Xylem and phloem are present in different radii alternating with each other. e.g. roots

(ii) Conjoint bundles:

Xylem and phloem lie on the same radius. There are two types of conjoint bundles.

a) Collateral:

- Xylem lies towards the centre and phloem lies towards the periphery.
- When cambium is present in collateral bundles, it is called open. e.g. dicot stem and collateral bundle without cambium is called closed. e.g. monocot stem

b) Bicollateral:

In this type of bundle, the phloem is present on both outer and inner side of xylem. e.g. *Cucurbita*

(iii) Concentric Bundles:

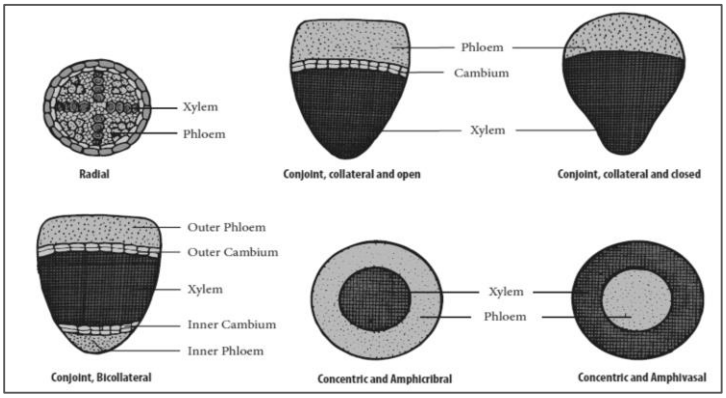
Vascular bundle in which xylem completely surrounds the phloem or vice versa is called concentric vascular bundle. It is of **two** types:

1. Amphivasal: Xylem surrounds phloem. ***E.g.*** *Dracaena*

2. Amphicribral: Phloem surrounds xylem. ***E.g.*** Ferns

Endarch: Protoxylem lies towards the centre and metaxylem lies towards the periphery. ***E.g.*** stem.

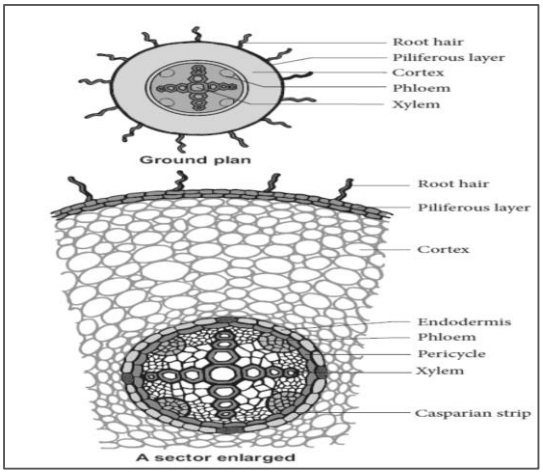
Exarch : Protoxylem lies towards the periphery and metaxylem lies towards the centre. **E.g.** roots.



2. Tabulate the tissue system and its functions.

Tissue System	Components	Functions
Dermal Tissue System	Epidermis and Periderm(in older stems and roots)	• Protection • Prevention of water loss
Ground Tissue System	Parenchyma tissue Collenchyma tissue Sclerenchyma tissue	• Photosynthesis • Food storage • Regeneration • Support • Protection
Vascular Tissue System	Vascular tissues - Xylem tissue - Phloem tissue	• Transport of water and minerals • Transport of food

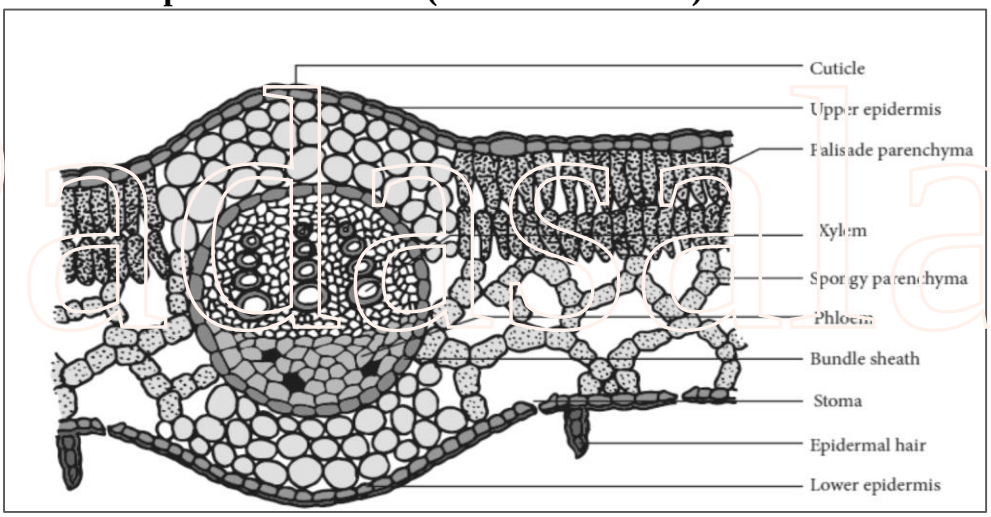
3. Draw the transverse section of Dicot root.



4. Differentiate between Dicot and Monocot stem.

Tissues	Dicot Stem	Monocot Stem
Hypodermis	Collenchymatous	Sclerenchymatous
Ground tissue	Differentiated into cortex, endodermis, pericycle and pith	Undiffertiated
Vascular bundles	(i) Less in number (ii) Uniform in size (iii) Arranged in a ring (iv) Open (v) Bundle sheath absent	(i) Numerous (ii) Smaller near periphery, bigger in the centre (iii) Scattered (iv) Closed (v) Bundle sheath present
Secondary growth	Present	Mostly absent
Pith	Present	Absent
Medullary rays	Present	Absent

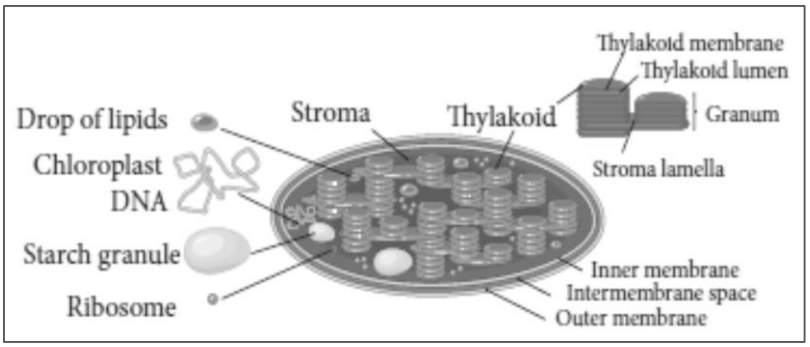
5. Draw and label the parts of Dicot leaf (transverse section)



6. Explain the structure of chloroplast with a suitable diagram.

Structure of Chloroplast:

- Chloroplasts are green plastids containing green pigment called **chlorophyll**.
- Chloroplasts are oval shaped organelles having a diameter of 2-10 micrometer and a thickness of 1-2 micrometer.



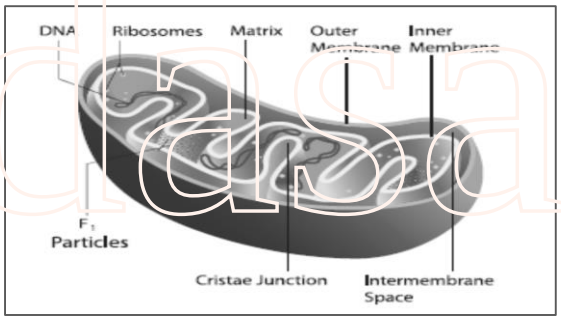
Envelope	Chloroplast envelope has outer and inner membranes which is separated by inter membrane space.
Stroma	Matrix present inside to the membrane is called stroma. It contains DNA, 70 S ribosomes and other molecules required for protein synthesis.
Thylakoids	It consists of thylakoid membrane that encloses thylakoid lumen. Thylakoids forms a stack of **disc like structures** called a grana (singular-granum).
Grana	Some of the thylakoids are arranged in the form of discs stacked one above the other. These stacks are termed as grana, they are inter connected to each other by membranous lamellae called **Fret channels**.

7. Explain the structure and function of mitochondria with a suitable diagram.

Structure of Mitochondria:

Mitochondrial Membranes:

- It consists two membranes called inner and outer membrane.
- Each membrane is 60-70A˚ thick. Outer mitochondrial membrane is smooth and freely permeable to most small molecules.
- It contains enzymes, proteins and lipids.
- It has **porin molecules** (proteins) which form channels for passage of molecules through it.
- Inner mitochondrial membrane is semi permeable membrane and regulates the passage of materials into and out of the mitochondria. It is rich in enzymes and carrier proteins.
- It consists of 80% proteins and lipids.



Cristae :

- The inner mitochondrial membrane gives rise to finger like projections called cristae.
- These cristae increase the inner surface area (fold in inner membrane) of the mitochondria to hold variety of enzymes.

Oxysomes :

The inner mitochondrial membrane bear minute regularly spaced tennis racket shaped particles known as oxysomes (F1 particle). They involve in ATP synthesis.

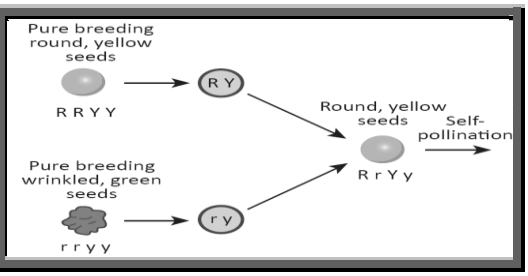
Mitochondrial matrix :

It is a complex mixture of proteins and lipids. Matrix contains enzymes for Krebs cycle, mitochondrial ribosomes(70 S), tRNAs and mitochondrial DNA.

Functions of Mitochondria :

- Mitochondria is the main organelle of cell respiration. They produce a large number of ATP molecules.
- So, they are called as **power houses of the cell** or **ATP factory of the cell**.
- It helps the cells to maintain normal concentration of calcium ions.
- It regulates the metabolic activity of the cell.

UNIT - 18
HEREDITY



POINTS TO REMEMBER

Genetics	The branch of biology that deals with the genes, genetic variation and heredity of living organisms is called ***Genetics***.
Genes	According to Mendel that 'factors' are passed on from one generation to another, now referred to as ***Genes***.
Chromosomes	The ***Chromosomes*** are the carrier of genetic material, which contain the heredity information.
DNA	***DNA*** is the hereditary material as it contain the genetic information. It is the most important constituent of a chromosome.
Sex Determination	The formation of zygote into male or female sex during development is called ***sex determination***. Sex is determined by the chromosome of an individual.
Mutation	Mutation is an inheritable sudden change in the genetic material (DNA) of an organism.
Alleles	Two factors making up a pair of contrasting characters are called ***Alleles*** or ***Allelomorphs***.
Dihybrid ratio	The ratio of each phenotype (or) appearance of seeds in the **F2 generation is 9:3:3:1**.
Laws of Heredity.	Based on his experiments of monohybrid and dihybrid cross, Mendel proposed three important laws which are now called as Mendel's ***Laws of Heredity***.
Chromosomes	The human body is made up of million cells. The nucleus of each cell contains thin thread like structures
Locus	Each gene is present at a specific position on a chromosome.
Chromonema	Each chromatid is made up of spirally coiled thin structure.
Chromomeres	A number of bead-like structures along the chromonema.
Centromere	The two arms of a chromosome meet at a point called ***primary constriction*** or ***centromere***.
Diploid (2n)	In the body cells of sexually reproducing organisms, the chromosomes generally occur in pairs. This condition is called ***diploid (2n)***.
Haploid (n)	The gametes produced by the organisms contain a single set of chromosomes. Hence, the gametes are said to be ***haploid (n).***
Idiogram	***Idiogram*** is the diagrammatic representation of karyotype of a species.
Autosomes	Autosomes contain genes that determine the somatic (body) characters**.** Male and female have equal number of autosomes**.**
Allosomes	Allosomes are chromosomes, which are responsible for determining the sex of an individual.

leading strand	In one strand, the daughter strand is synthesized as a continuous strand which is called ***leading strand.***
Gene mutation	***Gene mutation*** is the changes occurring in nucleotide sequence of a gene.
Euploidy	***Euploidy*** is the condition in which the individual bears more than the usual number of diploid (2n) chromosomes.

TEXTBOOK QUESTIONS

I. Choose the correct answer:

1. According to Mendel alleles have the following character
   a) Pair of genes **b) Responsible for character**
   c) Production of gametes d) Recessive factors
2. 9 : 3 : 3 : 1 ratio is due to
   a) Segregation b) Crossing over
   c) Independent assortment d) Recessiveness
3. The region of the chromosome where the spindle fibres get attached during cell division
   a) Chromomere b) Centrosome **c) Centromere** d) Chromonema
4. The centromere is found at the centre of the_____ chromosome.
   a) Telocentric **b) Metacentric** c) Sub-metacentric d) Acrocentric
5. The _____ units form the backbone of the DNA.
   a) 5 carbon sugar b) Phosphate c) Nitrogenous bases **d) Sugar phosphate**
6. Okasaki fragments are joined together by_____.
   a) Helicase b) DNA polymerase c) RNA primer **d) DNA ligase**
7. The number of chromosomes found inhuman beings are _____.
   a) 22 pairs of autosomes and 1 pair of allosomes.
   b) 22 autosomes and 1 allosome
   c) 46 autosomes
   d) 46 pairs autosomes and 1 pair of allosomes.
8. The loss of one or more chromosome in a ploidy is called _____.
   a) Tetraploidy **b) Aneuploidy** c) Euploidy d) polyploidy

II. Fill in the blanks

1. The pairs of contrasting character (traits) of Mendel are called **Alleles**.
2. Physical expression of a gene is called **phenotype**.
3. The thin thread like structures found in the nucleus of each cell are called **chromosomes**.
4. DNA consists of two **polynucleotide** chains
5. An inheritable change in the amount or the structure of a gene or a chromosome is called **Mutation**.

III. True or False: (if false give the correct statement)

1.	A typical Mendelian dihybrid ratio of F_2 generation is 3:1. ***(Correct Statement**: A typical Mendelian dihybrid ratio of F_2 generation is 9:3:3:1)*	**False**
2.	A recessive factor is altered by the presence of a dominant factor ***(Correct Statement:** A recessive factor is masked by the presence of a dominant factor)*	**False**
3.	Each gamete has only one allele of a gene.	**True**
4.	Hybrid is an offspring from a cross between genetically different parent.	**True**
5.	Some of the chromosomes have an elongated knob-like appendages known as telomere. *(**Correct Statement:** Some of the chromosomes have an elongated knob-like appendages known as satellite.)*	**False**
6.	New nucleotides are added and new complementary strand of DNA is formed with the help of enzyme DNA polymerase.	**True**
7.	Down's syndrome is the genetic condition with 45 chromosomes. ***(Correct Statement:** Down's syndrome is the genetic condition with 47 chromosomes.)*	**False**

IV. Match the following:

1. Autosomes	Trisomy 21
2. Diploid condition	9:3:3:1
3. Allosome	22 pair of chromosome
4. Down's syndrome	2n
5. Dihybrid ratio	23rd pair of chromosome

Answer
1. 22 pair of chromosome
2. 2n
3. 23rd pair of chromosome
4. Trisomy 21
5. 9:3:3:1

V. Answer in a sentence:

1. **What is a cross in which inheritance of two pairs of contrasting characters are studied?**
   Dihybrid cross is a cross in which inheritance of two pairs of contrasting characters are studied.
2. **Name the conditions when both the alleles are identical?**
   Homozygous condition.
3. **A garden pea plant produces axial white flowers. Another of the same species produced terminal violet flowers. Identify the dominant trait?**
   The dominant trait is Axial white flowers.
4. **What is the name given to the segments of DNA, which are responsible for the inheritance of a particular character?**
   Genes are the segments of DNA which are responsible for the in heritance of a particular character.
5. **Name the bond which binds the nucleotides in a DNA.**
   Phosphodiester bonds, kinds the nucleotides in a DNA.

VI. Short answer questions:

1. Why did Mendel select pea plant for his experiments?

- ❖ Pea plant is naturally self pollinating and so is very easy to raise pure breeding individuals.
- ❖ It has a short life span as it is an annual and so it was possible to follow several generations.
- ❖ It is easy to cross pollinate.
- ❖ It has deeply defined contrasting characters.
- ❖ The flowers are bisexual.

2. What do you understand by the term phenotype and genotype?

- ❖ Phenotype - External expression of a particular trait is known as phenotype.
- ❖ Genotype - The genetic expression of an organisms.

3. What are allosomes?

- ❖ Allosomes are chromosomes, which are responsible for determining the sex of an individual. They are also called sex chromosomes (or) hetero chromosome.
- ❖ Human male have XY chromosomes.
- ❖ Human Female have XX chromosomes.

4. What are Okazaki fragments?

The short segments of DNA are called Okazaki fragments. The fragments are joined together by the enzyme DNA ligase.

5. Why is euploidy considered to be advantageous to both plants and animals?

Euploid considered to be advantageous to both plants and animals, as they often result in increase fruit and flower size.

6. A pure tall plant (TT) is crossed with pure dwarf plant (tt), what would be the F_1 and F_2 generations? Explain.

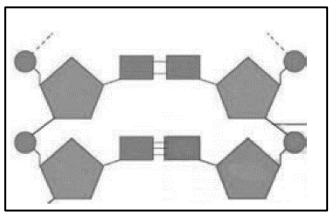
- ❖ F_1 plants are Hybrid tall (Tt)
- ❖ In the F_2 generation 3 different type were obtained.
  - Tall Homozygous - TT - pure - 1
  - Tall Heterozygous - Tt - 2
  - Dwarf Homozygous - tt - 1
- ❖ So the genotype ratio = 1:2:1

7. Explain the structure of a chromosome.

- ❖ The chromosomes are thin, long and thread like structures consisting of two identical strands called sister chromatids.
- ❖ They are held together by the centromere.
- ❖ A chromosome consists of the following regions.
  - Primary constriction
  - Secondary constriction.
  - Telomere
  - Satellite
- ❖ The chromosomes are made up of DNA, RNA chromosomal proteins C histones and non - histones and certain metallic ions. These proteins provide structural support to the chromosome.

8. Label the parts of the DNA in the diagram given below. Explain the structure briefly.

- ❖ DNA is a large molecule consisting of millions of nucleotides. Hence, it is also called a polynucleotide.
- ❖ Each nucleotide consists of three components.
  - a) A sugar molecule - Deoxyribose sugar
  - b) A nitrogenous base - There are two types of nitrogenous base in DNA. They are,
    - Purines (Adenine and Thymine)
    - Pyrimidines (Cytosine and Thymine)
  - c) A Phosphate group
- ❖ Adenine links thymine with two hydrogen bonds, cytosine links guanine with three hydrogen bonds.



VII. Long answer questions:

1. Explain with an example the inheritance of dihybrid cross. How is it different from monohybrid cross?

- ❖ Dihybrid cross involves the inheritance of two pairs contrasting traits at the same time.
- ❖ Mendel crossed pea plants having round yellow seed with pea plants having wrinkled green seeds. In F1 round yellow seeds were produced.
- ❖ When the hybrids of F1 generation pea plants having round yellow seeds were cross-bred by self-pollination then four types of seeds having different combinations of shape and color were obtained in F2.
- ❖ They were,

  Round Yellow -9
  Round green - 3
  Wrinkled yellow - 3
  Wrinkled green - 1
  The phenotypic ratio is 9:3:3:1
- ❖ From the above results, it can be concluded that the factors for each character (or) trait remains independent and maintain their identity in the gametes. The factors are independent to each other and pass to the off springs.

Monohybrid cross	Dihybrid cross
1. Crosses involving inheritance of only one pair of contrasting characters are called monohybrid cross.	Cross involving inheritance of two pairs of contrasting characters are called Dihybrid cross.
2. Example : Tall Plant × Dwarf plant (Height of the plant)	Example: yellow × Wrinkled green (Shape and colour of the seed)
3. The phenotypic ratio is 3:1	Phenotypic ratio is 9:3:3:1

2. How is the structure of DNA organised? What is the biological significance of DNA?

- ❖ DNA is the hereditary material as it contain the genetic information.
- ❖ The most widely accepted model or DNA is the double helical structure of **James Watsib** and **Frabcis Crick**.
- ❖ They proposed the three-dimensional model of DNA on the basis of X - ray diffraction studies of DNA obtained by **Rosalind Franklin** and **Manrice Wilkies**.

❖ In appreciation of their discoveries on the molecular structure of nucleic acid s **Watson**, **Crick** and **Wilkins** were awarded Nobel Prize form medicine in 1962.

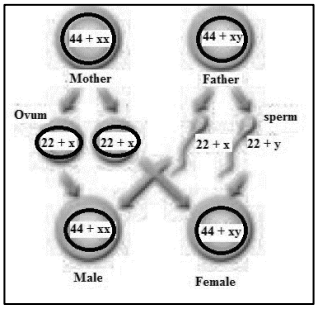
Significance of DNA:

❖ DNA is responsible for the transmission hereditary information from one generation to next generations.

❖ It contains information required for the formation of proteins.

❖ It controls the developmental process and life activities of an organism.

3. The sex of the newborn child is a matter of chance and neither of the parents may be considered responsible for it. What would be the possible fusion of gametes to determine the sex of the child?



❖ Human beings have 23 pairs of chromosomes out of which 22 pairs are autosomes and one pair (23rd pair) is the sex chromosomes.

❖ The female gametes (or) the eggs formed are similar in their chromosome type (22+xx). So, human females are homogametic.

❖ The male gametes (or) sperms produced are of two types. They are produced in equal proportions.

- The sperm bearing 22 + x chromosomes.
- The sperm bearing 22 + y chromosomes. So human males are called heterogametic.

❖ If the egg (z) is fused by the x - bearing sperm an xx individual (female) is produced. If the egg (x) is fused by the y - bearing sperm an xy individual (male) is produced.

VIII. HOT Questions:

1. Flowers of the garden pea are bisexual and self-pollinated. Therefore, it is difficult to perform hybridization experiment by crossing a particular pistil with the specific pollen grains. How Mendel made it possible in his monohybrid and dihybrid crosses?

Self pollination takes place in Mendel 's peas. The experimenter can remove the another from one flower before fertilization. It is called as Emasculation. Then he transfer the pollen grains from another variety of pea to the stigma of flowers, where the anthers are removed. This results in cross fertilization, which leads to the creations of hybrid varieties with different traits.

2. Pure-bred tall pea plants are first crossed with pure-bred dwarf pea plants. The pea plants obtained in F_1 generation are then cross-bred to produce F_2 generation of pea plants.

a. What do the plants of F_1 generation look like?

They are Hybrid tall plants having Tt genes.

b. What is the ratio of tall plants to dwarf plants in F_2 generation?

In F2 generation - the Phenotypic ratio 3:1 (3 Tall plants : 1 Dwarf plant)

Genotypic Ratio - 1:2:1

(1 TT - Homozygous tall, 2Tt - Heterozygous tall, 1 tt - Heterozygous dwarf)

c. Which type of plants were missing in F_1 generation but reappeared in F_2 generation?

Dwarf type of plants (Recessive trait)

3. **Kavitha gave birth to a female baby. Her family members say that she can give birth to only female babies because of her family history. Is the statement given by her family members true. Justify your answer.**
   - ❖ Human Females are homogametic because eggs formed are similar in their chromosome type (22 + x)
   - ❖ Human males are called hetero gametic, because he produces two types of sperm.
     1. The sperm bearing 22 + x
     2. The sperm bearing 22 + y
   - ❖ If the egg (x) is fused by the x - bearing sperm an xx individual (female) is produced.
   - ❖ If the egg (x) is fused by the Y - bearing sperm an xy individual (male) is produced.
   - ❖ The sperm produced by the father, determines the sex of the child. So Kavitha and her family is not responsible.

IX. value based question:

1. Under which conditions does the law of independent assortment hold good and why?

- ❖ Mendel first crossed pure breeding pea plants having round yellow seeds with pure breeding pea plants having wrinkled green seeds, and in F_1 all the plants are having round yellow seeds (Hybrids).
- ❖ When these hybrids were crossbred, 4 types of seeds having different combinations were obtained in F_2.
- ❖ They were, round Yellow / round, green /wrinkled yellow and wrinkled green seeds.
- ❖ In case of inheritance of two or more pairs of characters, simultaneously the factors or genes of one pair assort on independently of the other pair.

ADDITIONAL QUESTIONS

I. Choose the correct answer:

1. Mendel had chosen _____ pairs of contrasting traits in pea.
   a) 5 b) 6 **c) 7** d) 8
2. Punnett square is a checker board form devised by R.C.Punnett, which explains
   a) Morphological characters
   b) Anatomical characters
   c) Type of Hybridization
   d) To calculate the probability of all possible genotypes of offspring's in a genetic cross.
3. Which law is called as Mendel's Laws of Heredity?
   a) Law of Dominance b) Law of Segregation
   c) Law of independent assortment **d) All of the above**
4. The end of the chromosome is called
   a) Telomere b) primary constriction c) 7secondary constriction d) satellite
5. Monosomy is
   a) 2n + 1 **b) 2n - 1** c) 2n + 2 d) 2n - 2

II. True or False: (if false give the correct statement):

1.	Mendel conducted his experiments in Pea plants from 1856 to 1865	**True**
2.	The centromere occurs in the centre of the chromosome, it is called telocentric. ***(Correct statement:*** *The centromere occurs in the centre of the chromosome, it is called meta centric.**)***	**False**
3.	There are two types of nitrogenous bases in DNA. They are purines and pyrimidines.	**True**
4.	The formation of zygote into male (or) female sex during development is called gametogenesis. ***(Correct statement:*** *The formation of zygote into male (or) female sex during development is called sex determination.)*	**False**
5.	The term Euploidy was introduced by Hugs De Vries in 1901, when he observed phenotypic changed in the plant Oenothera lamarckiana. ***(Correct statement:*** *The term **mutation** was introduced by Hugs De Vries in 1901, when he observed phenotypic changed in the plant Oenothera lamarckiana.)*	**False**

III. Match the following:

1. chromosome	Specific position of a gene
2. Locus	Waldeyer
3. J (or) L shaped chromosomes	Nullisomy
4. 2n - 2	Point mutation
5. Gene Mutation	Submeta centric

Answer

1. **Waldeyer**
2. **Specific position of a gene**
3. **Submeta centric**
4. **Nullisomy**
5. **Point mutation**

IV. Assertion and Reasoning:

1. Assertion: The two arms of a chromosome meet at a point called primary constriction (or) centromere.

Reason : The centromere is the region where spindle fibres attach to the chromosomes during cell division.

a) Assertion is correct but reason is wrong.
b) Assertion is wrong but reason is correct
c) Both assertion and reason is correct
d) Both assertion and reason is wrong.

2. Assertion: Karyotype is the number, size and shape of chromosomes in the cell nucleus of an organism.

Reason: The diagrammatic representation of karyotype is known as chargaff rule.

a) Assertion is correct, Reason is wrong.
b) Assertion is wrong. Reason is correct.
c) Both are correct
d) Both are wrong.

V. Answer in a sentence:

1. Define - Gene?

Gene are segments of DNA, which are responsible for the inheritance of a particular phenotypic character.

2. What is diploid?

In the body cells of sexually reproducing organisms, the chromosomes generally occur in pairs. This condition is called diploid (2n).

3. Write about Idiogram?

Idiogram is the diagrammatic representation of karyotype of a species.

4. What is Nucleoside and Nucleotide?

a) Nucleoside = Nitrogen base + sugar
b) Nucleotide = Nucleoside + Phosphate

5. What is Mutation?

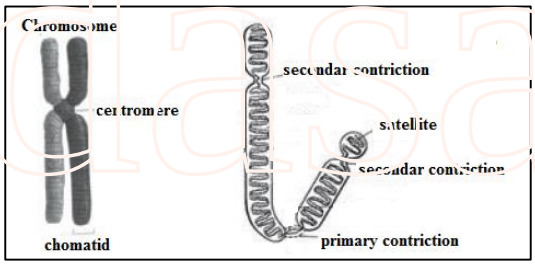
Mutation is an inheritable sudden change in the genetic material (DNA) of an organism.

VI. Short answer questions:

1. Write the law of dominance?

When two homozygous individuals with one or more sets of contrasting characters are crossed, the characters that appear in the F_1 hybrid are dominant and those that do not appear in F1 are recessive characters.

2. Draw the structure of chromosome and label the parts?



3. What are the three components in a nucleotide?

1. A sugar molecules - Deoxyribose sugar
2. A nitrogenous base

Purines	pyrimidines
1. Adenine	1. Cytosine
2. Guanine	2. Thymine

3. A Phosphate group

4. Write the functions of helicase and topoisomerase?

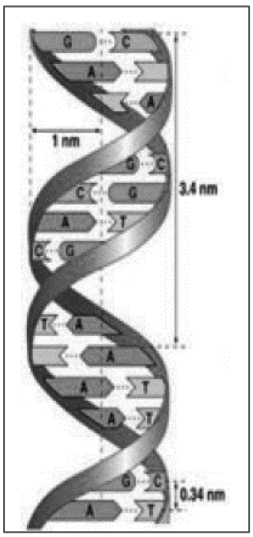
- **Helicase -** The enzyme called helicase, bind to the origin of replication site. Helicase separates the two strands of the DNA.
- **Topoisomerase -** This enzyme separates the double helix above the replication fork and remove the twists formed during the unwinding process.

5. Write the changes in the structure of chromosomes?

- Deletion
- Duplication
- Inversion
- Translocation

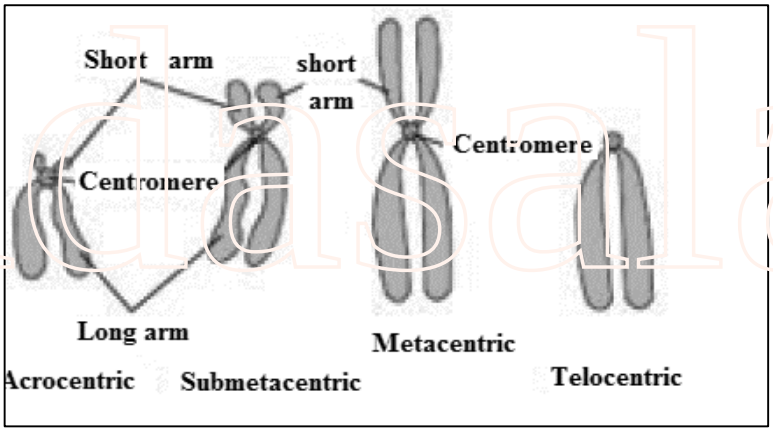
VII. Long answer questions:

1. **Explain Watson and Crick model of DNA with a suitable diagram?**



- DNA molecule consists of two **polynucleotide** chains.
- These chains form a **double helix** structure with two strands, which run **anti-parallel** to one another.
- **Nitrogenous bases** in the centre are linked to **sugar-phosphate** units, which form the backbone of the DNA.
- Pairing between the nitrogenous bases is very specific and is always between purine and pyrimidine linked by hydrogen bonds.
- Adenine (A) links Thymine (T) with two hydrogen bonds (A = T)
- Cytosine (C) links Guanine (G) with three hydrogen bonds (C ≡ G). This is called **complementary base pairing**.
- Hydrogen bonds between the nitrogenous bases make the DNA molecule stable.
- Each turn of the double helix is 34 A°(3.4 nm). There are ten base pairs in a complete turn. The nucleotides in a helix are joined together by phosphodiester bonds.

2. **How can we classify the chromosomes based on the position of centromere? Draw the diagrams.**



Telocentric	The centromere is found on the proximal end. They are rod shaped chromosomes.
Acrocentric	The centromere is found at the one end with a short arm and a long arm. They are also rod-shaped chromosomes.
Submetacentric	The centromere is found near the centre of the chromosome. Thus forming two unequal arms. They are J shaped or L shaped chromosomes.
Metacentric	The centromere occurs in the centre of the chromosome and form two equal arms. They are V shaped chromosomes.